

Reframing Buyer-Supplier Agency Problems Beyond the Dyad

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ABSTRACT

While agency problems inevitably exist in buyer-supplier relationships, the focus on how to overcome such problems has been confined to the buyer-supplier dyad as if the dyad exists in isolation. In this dissertation, I re-frame the agency problems beyond the dyadic relationship between a buyer and its supplier and suggest a new way to overcome agency problems. While the current Agency Theory suggests that the buyer can monitor and provide incentives to mitigate the agency problems, I propose to look beyond the dyad in addressing buyer-supplier agency problems.

In the first chapter, I examine the impact of the “indirect links” in which the buyer is connected to the supplier through a third actor. I propose a conceptual framework that specifies how the indirect links can overcome agency problems through the effects of information exchange, mutual monitoring, power change, and network governance. These different effects are enabled by the indirect links based on the different network positions and levels of connectivity of the third actor. The first chapter provides a theoretical framework for Chapter 2 and 3.

In Chapter 2, the effect of network governance enabled by the indirect links is investigated. In particular, two scenario-based role-play experiments were conducted with managers to examine the effects of dyadic and network governance mechanisms on supplier opportunism. In Study 1, the participants took the perspective of a supplier, while in Study 2, the participants took the role of a buyer. The results show that network governance mechanism reduces the supplier’s opportunistic behavioral intentions directly and indirectly through the negative affection prediction, and while suppliers may overlook the buyer’s reactions as they make decisions, the buyers are likely to react against the supplier, such as engage in negative word-of-mouth or reduce level of commitment.

Finally, directed sourcing, a direct application of how a buyer could overcome

agency problems beyond the dyad, is examined in Chapter 3. Directed sourcing is an emerging sourcing practice in which the buying firms bypass the top-tier suppliers and directly manage or contract with lower-tier suppliers, and research on this new practice is in its infancy. Therefore, multi-tier multi-task principal-agent models are developed to investigate the effect of directed sourcing practice on each member in this three-tier supply chain, comparing with traditional tiered sourcing. The results show that directed sourcing generally benefits the original equipment manufacturer (OEM) and the lower-tier supplier, while it harms the top-tier supplier. Yet, directed sourcing is not always beneficial to the OEM. Therefore, an OEM should be selective in implementing this new strategy.

DEDICATION

To my husband, Liang Sun: You have always been and always will be my partner in all things. Without your love, support, help and infinite patience, none of this would have happened, and I would not be who I am today without you.

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Chapter 1

BEYOND THE DYAD: ADDRESSING AGENCY PROBLEMS THROUGH INDIRECT LINKS

Abstract

Conflicts are an inevitable part of buyer-supplier relationships. To overcome conflict, such as goal incongruence and information asymmetry, agency theory suggests that the buyer should devise ways to monitor supplier behavior and to incentivize the supplier through contractual terms. A critical departure from the current state of the literature occurs from an observation that these strategies are confined to the dyadic context. When we expand our perspective beyond the buyer-supplier dyad, we see indirect links that connect the buyer and supplier through other interorganizational actors. In particular, we consider the indirect links that occur through the supplier's supplier, the buyer's other supplier, the supplier's other customer, and the buyer's customer. We propose that these different indirect links could enable the effects of information exchange, mutual monitoring, power, and network governance and, thus, change the dynamics in the buyer-supplier dyad. We propose that the use of indirect, interorganizational links offers a new perspective to address agency problems, complementary to monitoring and incentivizing. This paper extends agency theory beyond the dyadic context, and suggests that managers should look outside the buyer-supplier dyad for opportunities to resolve relational conflict.

1.1 Introduction

Conflicts between a buying firm and its suppliers are unavoidable. Such conflicts can be counterproductive and often require considerable corporate resources. They are prevalent in adversarial or transactional relationships (Ellram and Carr, 1994; Burnes and New, 1997; Ellram, 1991), but can exist also in collaborative relationships (Rossetti and Choi, 2005; Krause and Ellram, 2014; Jia and Zsidisin, 2014; Richey et al., 2010), including relationships with high levels of trust and commitment (Read et al., 2014; Morgan and Hunt, 1994; Ellinger et al., 2006; Mohr and Spekman, 1994).

For example, LGE had difficulties working with Qualcomm, its CDMA-chip supplier. Despite their long-term relationship, the two companies were constantly jockeying for leverage (Choi and Linton, 2011). LGE reasoned it was the principal, and was spending about \$1 Billion annually on this supplier, while Qualcomm countered by reminding LGE that it owned the intellectual property on CDMA technology. According to agency theory, such conflicts in a buyer-supplier relationship are due to goal incongruence and information asymmetry and can be mitigated through mechanisms such as monitoring by the buyer and providing incentives to the supplier. LGE worked hard to solve this issue by adding incentive terms and by building a close relationship with Qualcomm. Yet, the problem persisted. Similar conflict exists in most buyer-supplier relationships. For example, a supplier may not act as responsively to the buyer's requests as it should, or it may intentionally slow down the transfer of information to the buyer even in a long-term relationship. According to Kim and Choi (2015), Apple and Boeing are "seeing signs of deterioration in some of their long-standing relationships with cooperative suppliers" (Kim and Choi, 2015).

One possible reason why conflict persists, even though agency theory suggests

that it should be minimized through monitoring and incentives, is that the effort that the buyer has been making focuses solely on the relationship itself. In other words, the buyer rarely goes beyond the buyer-supplier dyad when it is trying to resolve issues with the supplier. Interestingly, once LGE moved beyond the dyad by forging an informal relationship with TSMC, its second-tier supplier that manufactures the CDMA-chips for Qualcomm, it discovered that Qualcomm became more accommodating. This example illustrates how the current literature and practices in buyer-supplier relationships, confined in the dyad, may benefit from considering external ties within which the dyad is embedded.

From the perspective of agency theory, the buyer, as the principal, inevitably faces agency problems with its supplier, the agent (Eisenhardt, 1989; Fama, 1980; Harris and Raviv, 1978). Such buyer-supplier relationships have been analyzed through agency theory (Rossetti and Choi, 2008; Balakrishnan et al., 2008; Lado et al., 2008; Weigelt and Sarkar, 2009; Frankel et al., 2008; Fugate et al., 2006; Rungtusanatham et al., 2007). However, there have been calls to consider buyer-supplier relationships beyond the dyadic context (Worsham et al., 1997; Choi and Kim, 2008). More specifically, there is an opportunity to consider the buyer-supplier relationship as having extended ties within a broader interorganizational network.

As a next logical step to investigate the role of extended ties in addressing the agency problem between the buyer and the supplier, we consider one neighboring node and indirect links that pass through this node. In the buyer-supplier context, a neighboring node can be the supplier's supplier, the supplier's other customer, the buyer's other supplier, or the buyer's customer. And the term indirect links is defined as the links between two actors through other actors in the common network.

Such indirect links outside the buyer-supplier dyad are complimentary to monitoring and incentivizing as suggested by the current perspective of agency theory (Eisen-

hardt, 1989; Shapiro, 2005). In the following sections, we first offer an overview of relevant concepts and principles in agency theory and briefly review how agency theory has been applied in the buyer-supplier relationship literature. To develop our theoretical framework and propositions, we first define indirect links and then explain how buying firms can address agency problems by managing the indirect links. We focus on the effects of information, mutual monitoring, power, and network governance and discuss how different indirect links could enable these effects. We also discuss the limitation for using indirect links for agency problems. Lastly, we discuss implications for researchers and practitioners and offer directions for future research.

1.2 Overview of Agency Problems in the Buyer-Supplier Context

1.2.1 Agency Problems in the Buyer-Supplier Context

At its core, agency theory discusses the problems in a principal-agent relationship (Ross, 1973; Jensen and Meckling, 1976). The principal engages the agent to perform a task “which involves delegating some decision making authority to the agent” (Jensen and Meckling, 1976, p.308). The goal of the principal is to have the agent perform the task as if the principal itself were doing so (Eisenhardt, 1989). However, “if both parties ... are utility maximizers, there is good reason to believe that the agent will not always act in the best interests of the principal” (Jensen and Meckling, 1976) (p.308). The deviation between the agent’s actual behaviors and the behaviors in the interests of the principal is called the “agency problem” (Eisenhardt, 1989; Shapiro, 2005).

The agency problem arises when “the desires or goals of the principal and agent conflict” (goal incongruence) and when “it is difficult or expensive for the principal to verify what the agent is actually doing” (information asymmetry) (Eisenhardt, 1989,

p.58). Goal incongruence has been associated with goal misalignment, goal conflict, and goal incompatibilities in the literature (Das and Rahman, 2010; Handley and Benton Jr., 2009; Rossetti and Choi, 2008). For example, considering a manufacturer-distributor relationship (Lassar and Kerr, 1996), the distributor may pursue its own goals of maximizing sales of all the products which it carries, in ways that conflict with the manufacturer’s broader interests of maximizing sales of its own products. In the supply chain literature, buyers and suppliers typically experience misalignment in their financial and operational goals (Rossetti and Choi, 2008).

Besides goal incongruence, information asymmetry is another key contributor to the agency problem (Eisenhardt, 1989, p.58). The agent’s actual behaviors are often inaccessible to the principal (Hendry, 2002; Jacobides and Croson, 2001); otherwise, the principal could create a “perfect” contract that compensates the agent based on the its actual behaviors (Eisenhardt, 1989). In the case of adverse selection, a downstream distributor may intentionally misrepresent its capabilities to win a contract (Wallace et al., 2009). Information asymmetry also contributes to agency problems after the agent is selected. A typical problem is moral hazard – a lack of effort on the part of the agent Hölmstrom (1979). A supplier could use low quality material or labor for its own savings, and such behaviors are often unknown to the buyer at the time of delivery (Rao et al., 1999; Eisenhardt, 1989; Hölmstrom, 1979).

1.2.2 Overcoming Agency Problems in the Buyer-Supplier Context

Agency problems can be overcome by the use of contractual terms that align “the agent’s preferences with those of the principal” (Eisenhardt, 1989, p.61). With appropriate incentive terms, the discrepancy between the agent’s and the principal’s objective functions decreases, and the agent is more likely to choose actions that favor both parties (Ross, 1973). This issue has been well studied in the management

literature, e.g., the CEO's actions are better aligned with the shareholders' goals when he/she is incentivized with stock options (DeMott, 1997; Tosi et al., 1997; Wageman and Baker., 1997; Wright et al., 2007).

Similar practices to incentivize suppliers are suggested in the supply chain literature (Giunipero, 1990). Traditionally, buyers use market-based incentives (e.g., increased volumes of present business and priority consideration for future business) based on the evaluation criteria that align with the buyer's goals (Monczka et al., 1993; Giunipero, 1990; Krause et al., 2000). Yet such incentives are usually accompanied by competitive pressure created by the buyer so that the relationship between a buyer and its supplier is often short-term (Dyer and Ouchi, 1993; Giunipero, 1990). Since the Japanese manufacturers entered the U.S. in the 1980's, the quality and cost gap caused by such a short-term orientation became salient. Supply base reduction was practiced and long-term oriented relationships were built between buyers and suppliers (Terpend et al., 2008; Krause, 1999; Krause et al., 2001). Such relationships incentivize the suppliers through the increasing sense of security in future contracts so that the suppliers are more committed to the buyer and the goal incongruence is reduced (Choi and Wu, 2009; Kwon and Suh, 2004; Dionisis et al., 2002). Further, buyers have also employed supplier development programs which improve supplier performance and increase interdependency (Monczka et al., 1993; Newman and Rhee, 1990; Krause et al., 2000). Transaction-specific investments also incentivize the suppliers through more secured future contracts and increase the suppliers' willingness to trust and commit to the buyer (Dyer and Chu, 2011; Krause et al., 2007; Dionisis et al., 2002; Kwon and Suh, 2004; Williamson, 1981).

Another way to address agency problems is monitoring. Monitoring refers to "observation of agent efforts or outcomes that is accomplished through supervision, accounting control, and other devices" ((Tosi et al., 1997, p.588). Since monitor-

ing informs the principal about what the agent is actually doing, “they are likely to curb agent opportunism because the agent will realize that he or she cannot deceive the principal” (Eisenhardt, 1989, p.60). For example, the management literature has demonstrated that managers are more disciplined when they are closely monitored by shareholders directly or indirectly through a third party or efficient capital and labor markets, or by installing an information system (Demsetz and Lehn, 1985; Shleifer and Vishny, 1986; Walsh and Seward, 1990; Lane et al., 1998; Fama, 1980; Fama and Jensen, 1983). Similarly, supply managers have also adopted practices to overcome information asymmetry occurring in supplier selection and supplier management. For example, assessing a supplier for its innovation capabilities and long-term manufacturing potential would allow the buyer to collect more accurate and updated information to mitigate the problem of adverse selection (Choi and Hartley, 1996; Giunipero, 1990; Krause et al., 2000). In addition, some buyers also directly involve themselves in the supplier development effort and dedicate personnel temporarily to the supplier (Monczka et al., 1993; Newman and Rhee, 1990; Krause et al., 2000). The direct involvement allows the buyer to gain more real and detailed information about the suppliers’ processes and activities, which reduces the potential problem of shirking. Supplier integration and the adoption of inter-organizational information systems (e.g., ERP systems) also contribute to the reduction of information asymmetry in a similar manner (Andersen and Buvik, 2001; Carr and Pearson, 2002; Guan and Rehme, 2012; Holland et al., 1992; Terpend et al., 2008). Most of these practices are considered as means to monitor or to improve the efficiency of monitoring.

However, both the incentive and monitoring approaches are confined in the principal-agent dyad and can be ineffective. While the incentive approach transfers risks to the agents, who are generally more risk averse (Lane et al., 1998; Tosi et al., 1997; Waterman and Meier, 1998; Eisenhardt, 1989), the effect of monitoring is threatened

due to measurement imperfection, multiple tasks in agency relations, ex ante causal ambiguity, and reactance caused by offending the agent’s sense of autonomy (Jacobides and Croson, 2001; Williamson, 1975; Tosi et al., 1997; Sharma, 1997; Baker, 1992; Brehm, 1966; Heide et al., 2007). Therefore, we introduce the concept of indirect links that extend beyond the buyer-supplier dyad to address agency problems in a broader context.

1.3 Indirect Links and the Effects on Buyer-Supplier Agency Problems

The buyer-supplier dyad is embedded in a broader network of organizations. Within a network, a node can connect with another node directly or indirectly (Granovetter, 1973). Figure 1.1 illustrates the direct and indirect links involving a dyad and an additional node. The A-B link represents the direct, buyer (A)-supplier (B) link, and the A-C and B-C links combined are the indirect links connecting A and B. Here, A and B are linked directly in a buyer-supplier relationship and indirectly through a third firm, and we define the indirect links as a set of links that connect the buyer-supplier dyad through an external node.

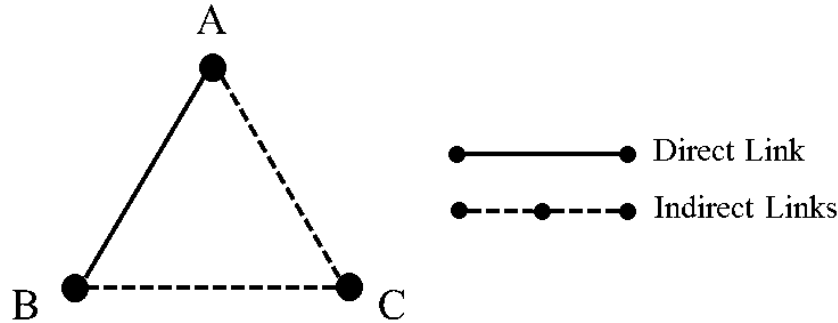


Figure 1.1: Direct and Indirect Links Between Node A and B

From a structural perspective, there are four positions that the external nodes could occupy, relative to the buyer-supplier dyad, to form a triad (Bastl, Johnson, and

Choi 2013). In the order of a typical material flow, the four positions are: (1) upstream to the supplier, e.g., the supplier’s supplier; (2) horizontal to the supplier, e.g., the buyer’s other supplier; (3) horizontal to the buyer, e.g., the supplier’s other customer; and (4) downstream to the buyer, e.g., the buyer’s customer. These four positions generally represent all types of business relationships within a supply network ¹ . Table 1.1 demonstrates the four types of indirect links and offers industry examples in the right-hand column (Caro et al., 2015; Choi and Linton, 2011; Wu and Choi, 2005).

Due to the nature of the business relationships, indirect links that go through a third node will influence the focal buyer-supplier agency problems in different ways. Therefore, we propose four effects enabled by the indirect links and discuss in detail how these effects could address the focal buyer-supplier agency problems.

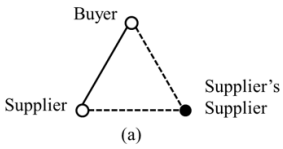
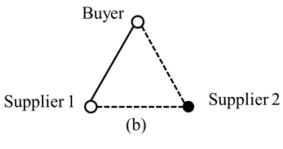
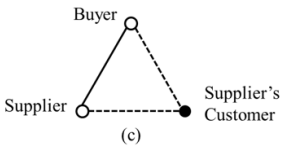
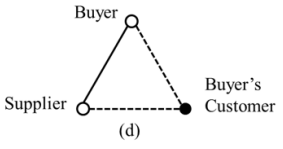
1.3.1 The Effect of Information Exchange Enabled by Indirect Links

As we look beyond the focal buyer-supplier dyad, we start to see how the buyer could reduce information asymmetry by connecting to a third node that holds information that is unavailable to the buyer. For example, a buyer’s trust in a supplier can be “granted on the basis of the supplier’s history in relationships with other firms” (Doney and Cannon, 1997, p.38). A buyer can use the information from other organizations to verify the supplier’s claims and actions.

The third node can be a supplier’s supplier or its customer, which usually has first-hand experience with the supplier and holds information that may not be readily known by the buyer. When connecting the supplier’s supplier, the buyer notices how this third organization could disclose new information often blocked by its supplier.

¹Although other types of links, such as a link with government, a university, or an industry association, exist and could influence the buyer-supplier dyad, we focus our framework on business relationships.

Table 1.1: Identification of Indirect Links

Structural configurations	External node	Examples
	Supplier's supplier	LGE (the buyer) and Qualcomm (the supplier) were constantly jockeying for leverage. LGE was spending about \$1 Billion annually on this supplier, but Qualcomm owned the intellectual property on the technology LGE needed. When LGE began meeting with TSMC (the supplier's supplier), its relationship with Qualcomm began to change.
	Buyer's other supplier	The buyer had an established relationship with supplier 1 but started to work with supplier 2 to reduce the overall supply risk. Suppliers 1 and Supplier 2, two competing suppliers that would normally not engage in communications and engineering exchanges, were working together on projects specific to the buyer.
	Supplier's other customer	ACCORD India, a chief executive search firm in India, which is providing a platform for buyers to share their supplier auditing reports regarding the suppliers' compliance with corporate social responsibility practices. Although buyers publish such reports for their customers and investors, the same information benefits other buyers that work with the same supplier.
	Buyer's customer	The buyer, a construction company, decided to purchase an equipment from a supplier for an overseas project. When the supplier began having difficulty in meeting cost and delivery targets, the buyer turned to its customer for help. With more leverage and resources, the buyer's customer was able to remedy the situation.

For example, the supplier's supplier is likely to know more than the buyer about the quality and cost of the raw materials. In the LGE example (shown in Table 1.1(a)), a supplier such as Qualcomm would be concerned that LGE might find out more about its cost structure through its supplier, TSMC, which is LGE's second tier supplier. Further, by connecting to the supplier's supplier, the buyer is able to collect information about the supplier's behavior and performance that cannot be obtained through direct interaction with the supplier. Although collecting information from the supplier's supplier is likely to incur additional costs for the buyer, it provides new information that can be used to reduce the level of information asymmetry. In addition, since such information can be readily available to the supplier's supplier but not to the buyer, utilizing the indirect links through the supplier's supplier is likely to be more cost effective than direct monitoring.

Similarly, the buyer can obtain information about the supplier from the supplier's other customers. Directly or indirectly, firms participate in discourse and information exchange based on their experiences with whom they interact (Basdeo et al., 2006; Fombrun and Shanley, 1990). Choi and Kim (2008) proposed that buying firms should look beyond the dyad when they select suppliers. In one of their examples, Automaker 1 could not fully understand its supplier's behavior (i.e., falling short of quality requirements) until it began looking into this supplier's relationship with one of its other customers, Automaker 2. Had Automaker 1 been monitoring Automaker 2 and its relationship with this supplier, it could have taken more proactive measures. Therefore, it can be beneficial for a firm to know who its key supplier's other customers are, and how their relationship may affect the interaction between the supplier and itself. Another example is ACCORD India (shown in Table 1.1(c)), a chief executive search firm in India. This company provides a platform for buyers to share their supplier auditing reports regarding corporate social responsibility prac-

tices. Although buyers publish such reports for their customers and investors, the same information can benefit other buyers that work with the same supplier (Caro et al., 2015). Therefore, by connecting to the supplier’s other customer, the buyer can also obtain information about the supplier at a relatively low cost.

The same idea can be applied to the situation in which the third node is the supplier’s peer that has first-hand experience with the focal supplier and holds information that is valuable but not readily available to the buyer. In general, enabled by the indirect links through the supplier’s supplier, its customer, or its peer, the buyer could reduce the level of information asymmetry in the buyer-supplier relationship by more cost-effectively collecting information from other sources. This leads to our first proposition:

P1: *Indirect links external to the buyer-supplier dyad can be a source of information for the buyer to reduce the information asymmetry internal to the buyer-supplier dyad.*

1.3.2 The Effect of Mutual Monitoring Enabled by Indirect Links

Beyond the focal buyer-supplier dyad, the buyer interacts with other suppliers. When the other supplier does not compete directly with the focal supplier, the two suppliers can be engaged in monitoring each other’s behavior to internally control processes as well as to improve performance without the buyer’s intervention (Fama and Jensen, 1983). In the context of organizational hierarchies, upper level managers can monitor lower level managers and vice versa (Fama, 1980). The agents are motivated to monitor each other because their performance depends on, at least partially, the performance of the other agent, and because the agents perceive that such monitoring behavior can lead to rewards; for instance, lower level managers can short-circuit the “shirking or less competent managers above them” (Fama, 1980, p.293). When the

agents work closely with each other, mutual monitoring serves an important role in collecting low-cost information to address the agency problem.

We propose, in the supply chain context, that a buyer can create a relational structure similar to mutual monitoring. The buyer can bring together suppliers to collaborate on projects (Wu and Choi, 2005). Since the two suppliers are cooperating, the two suppliers receive first-hand information about each other at a lower cost. At the same time, given their dependence on each other’s performance, they would be motivated to monitor the other supplier to ensure that it is contributing its share. Jiang (2009), for instance, found that peer-to-peer governance is more effective for getting supplier compliance than buyer-to-supplier governance in the Chinese apparel and textile industry.

The “Coach” case in Wu and Choi (2005) (see Table 1.1(b)) demonstrates the mutual monitoring effect in the buyer-supplier relationship. By successfully creating a context for the two suppliers to engage in information sharing, the buying firm in essence has devised a mutual monitoring system utilizing the co-opetition condition between two suppliers. Also, Toyota initiated a context where its new US supplier is matched with its Japanese supplier to solve both technical and contractual issues (Tezuka, 1997; Dyer and Ouchi, 1993). In such conditions, the paired suppliers are motivated to monitor each other. Ultimately, such a supplier-supplier relationship reduces the monitoring costs from the buyer’s perspective since the cost of mutual monitoring is less than the cost of direct monitoring by the buyer.

For mutual monitoring to work well, the two suppliers may be in the same business but not in direct competition. A good example comes from the practice of parallel sourcing (Richardson, 1993), wherein suppliers that have the same capabilities are brought together and given contracts for different product lines. They have the same capabilities (e.g., tire manufacturing) but do not compete head on because each is

given a contract for different models (e.g., tires for a sedan, tires for an SUV, etc.). These suppliers are motivated to monitor each other because of the future implications of their present performance. In general, indirect links can enable supplier-to-supplier monitoring.

P2: *Indirect links when connected through another buyer’s supplier can be a means for the buyer to monitor the focal supplier in the buyer-supplier dyad.*

1.3.3 The Effect of Power Change Enabled by Indirect Links

According to the agency theory literature, the distribution of power between the principal and the agent is a critical factor (Fama, 1980). Combining agency theory and the power research, Saam (2007) argued that agency problems and the solution mechanisms should be considered as power phenomena because, as a principal and an agent interact, both jockey for leverage to potentially influence the other party’s beliefs, attitudes, or behaviors ². Although the buyer, as the principal, generally has more power than the agent because it can terminate the contract and contract with other suppliers to perform the work (Tosi Jr. and Gomez-Mejia, 1989), in reality this may not always be the case. For example, Canils and Gelderman (2007) found that the relative power and interdependence between a buyer and its supplier differs in each quadrant of the Kraljic portfolio matrix (Kraljic, 1983). For instance, suppliers have more power over buyers when dealing with bottleneck items. Therefore, an important consideration in overcoming the agency problem is to change the power

²Power, in general, refers to one party’s potential to influence another party’s belief, attitude or behavior (French & Raven, 1959). Among the six bases of power, reward and coercive power are considered mediated because their use is controlled and meditated by the influencing agent, while expert, referent and legitimate power are considered non-mediated, because the effects are based on the target’s perception (Tedeschi et al, 1972; Zhao et al, 2008). The locus of mediated powers is decisively dyadic in that the power dynamics are contained in the principal-agent relationship. The source of non-mediated power, in contrast, is dependent on the agent’s perception, and to that end, the locus of power rests with the agent. In this regard, the non-mediated power bases are more conducive to looking outside the immediate buyer-supplier dyad. Therefore, we focus our discussion on the non-mediated powers.

distribution. There are several types of indirect links that the buyer could build on to redistribute the power in its favor.

Through the supplier's other customer

In order to increase the supplier's relationship commitment and address agency problems, a buyer seeks ways to increase its power over the supplier (Benton and Maloni, 2005; Maloni and Benton, 2000; Zhao et al., 2008). One way to increase the buyer's power is to build a coalition with another customer of the supplier, whom the supplier depends on. When the power distribution in a buyer-supplier relationship favors the supplier, the buyer is likely to form a coalition with other buyers in the supply network (Bastl et al., 2013). When facing a powerful supplier, suppliers can form a purchasing consortium; for instance, farmers formed "co-ops" many decades ago, which was in essence buyers joining together and redistributing the negotiation power in their favor (Hendrick, 1996).

Through the supplier's direct competitor

Another way to change the power distribution is to have the buyer connect with a direct competitor of the supplier. In essence, a supplier's power over the buyer comes from the buyer's dependence on it (Emerson, 1962). The buyer could depend on the supplier to achieve certain goals because the supplier possess scarce resources (Dahl, 1957). These resources can include financial capital, human talent, technological skills, and the linkages between a focal firm and members of its supply chain (Rungtusanatham et al., 2003; Barney, 1991; Bouquet and Birkinshaw, 2008). In particular, Rajan and Zingales (1998) suggest that an alternative mechanism to allocate power is "access", defined as "the ability to use, or work with, a critical resource" (p. 388). Hickson et al. (1971) also argue that actors need to be interlinked to gain power,

because it is their connections that make their resources valuable, not necessarily the possession of resources per se. In contrast, if the buyer gains access to such resources, the supplier's relative power is reduced (Bouquet and Birkinshaw, 2008; Rajan and Zingales, 1998). As the power of the supplier decreases due to the introduction of competition through the indirect links, the supplier is more likely to act in the buyer's interest.

Through the buyer's customer

The buyer can also increase its own power over the supplier by creating an indirect link through its own customer. Similar to a coalition with the supplier's other customer, the buyer can work with its own customer who may possess more leverage over the supplier. In the construction example shown in Table 1.1(d), the construction company as the buyer failed to have its supplier meet cost and delivery targets after trying many different approaches. Eventually it was able to overcome the problem by turning to its customer for help. Because this customer is the key player of many overseas projects and controls resources that the supplier depends on, by forming a coalition with the customer, the buyer increased its leverage over the supplier and was able to obtain the supplier's compliance.

With an organization that is central in the inter-organizational network

Last but not least, the buyer can increase its power by connecting with an organization that is central in the network in which the buyer-supplier dyad is embedded. This central firm can be any firm in the extended network. In other words, the benefit created by the indirect links with this central organization comes from its centrality in the network rather than its direct interaction with the buyer-supplier dyad.

In particular, an actor is considered central in a network when it has connections

to many other actors, also called degree centrality³. Due to these connections, a central actor has information advantage and power over peripheral actors. This idea comes from social network theory (Burt, 1992; Granovetter, 1973, 1985), and has received considerable attention in the management literature (Astley and Sachdeva, 1984; Ibarra, 1993; Mizruchi and Bunting, 1981; Bouquet and Birkinshaw, 2008) and supply chain management literature (Kim et al., 2011; Carter et al., 2007). High centrality can be achieved not only through increasing the number of links (i.e. high degree centrality), but also through linking to other central actors (i.e., high Eigenvector centrality) (Bonacich, 1972, 1987, 2007; Mizruchi and Bunting, 1981). In particular, a buyer can gain power over the supplier by connecting to a central node. LGE increased its power by connecting to TSMC, which is considered to be central. Similarly, in the example provided in Table 1d, company C increased its power over company E by connecting to company B, which is central in the overseas construction industry network.

In sum, the buyer can potentially change the power distribution with regard to the focal supplier by connecting with the supplier’s other customer, the supplier’s direct competitor, the buyer’s customer, and a central third-organization. When the change in power favors the buyer, the supplier is more likely to comply with the buyer’s request and to behave in the buyer’s interest.

P3: *Indirect links external to the buyer-supplier dyad can affect the power distribution in a way that allows the buyer to gain leverage to reduce the supplier’s behavioral uncertainty caused by agency problems internal to the buyer-supplier dyad.*

³Other types of centrality, such as betweenness, and closeness centrality, can have a similar impact as the degree centrality. Thus for reasons of parsimony, they will not be discussed in this paper.

1.3.4 The Effect of Network Governance Enabled by Indirect Links

Connecting with a central third-organization not only increases the buyer's power, but also enables the effect of network governance mechanism. The buyer changes structural embeddedness, a key to the network governance mechanism, in its favor in the inter-organization network (Jones et al., 1997). According to Granovetter(1985; 1992), structural embeddedness "is a function of how many participants interact with one another, how likely future interactions are among participants, and how likely participants are to talk about these interactions" (Jones et al., 1997, p.927). In other words, as the structural embeddedness increases, the actors are more likely and have greater interest in obtaining and sharing the information about one another (Burt, 1992). Therefore, when the indirect links go through a central actor, the dyadic interaction between the focal buyer and supplier could be discovered by the other actors in the network more easily, and, therefore, the focal dyad is more embedded in the network.

According to Jones and the colleagues (1997), network embeddedness enables the mechanism of network governance, in addition to markets or hierarchies (Williamson, 1998). Network governance can resolve exchange problems through the social mechanism of collective sanctions and reputation. Collective sanctions reduce behavioral uncertainty by demonstrating the consequences of violating norms and values, increasing the costs of opportunism, and decreasing the costs of monitoring to any one party (Jones et al., 1997). With the indirect links through a central node, the supplier's behavior is more likely to be known and shared by the other actors in the network. In case its behavior violates group norms (e.g., shirking), not only the buyer but also other organizations can engage in exacting remedial actions against this supplier (i.e., poor reputation). Therefore, the indirect links through a central actor can

help safeguard transactions in the buyer-supplier dyad.

In addition, the increase of network embeddedness derived from connecting with a central node also increase the ease through which the supplier’s reputation information can be channeled. In general, a firm’s reputation refers to the perceptions by a firm’s audience (e.g., the firm’s customers) about how well the firm can provide value compared with its competitors (Doney and Cannon, 1997; Hess Jr, 2008; Philippe and Durand, 2011). According to the agency theory literature (Fama, 1980; Fama and Jensen, 1983), reputation plays an important role in the agent’s objective function so that it is influential to the agent’s behavior (Jacobides and Croson, 2001; Wagner et al., 2011). Since a favorable reputation is notoriously difficult to develop (Flanagan and O’shaughnessy, 2005) and usually requires significant long-term investment (Doney and Cannon, 1997), firms are reluctant to jeopardize their reputation and develop strategies to avoid reputation threats and damages (Telser, 1980). However, when the supplier is embedded in a sparse network or the buyer-supplier dyad is isolated from the majority of the network, the diffusion of agency problems, as a reputation threatening issue for the supplier, would be less and slower (Borgatti and Foster, 2003; Granovetter, 1985). The supplier can effectively limit the negative impact on reputation by blocking the signaling channels.

We propose that the formation of the indirect links through a central actor can facilitate the channels of the reputation signaling process so that the supplier has to change its actual behavior in order to limit the negative impact of agency problems on its reputation. By creating a link to a well-connected firm in the network, there is a better chance that the supplier’s behaviors will be known to the market (Granovetter, 1985). Therefore, by connecting to a central node, the buyer increases the supplier’s concern of its reputation and unblock the channels for the reputation signaling process, and therefore deters the supplier’s deceptive behavior (Parkhe, 1993).

In sum, by connecting through a central actor in the network, the buyer-supplier dyad increases its network embeddedness which enables the mechanism of network governance. Through the effect of collective sanctions and reputation, the supplier is likely to behave in the buyer's interest, and thus, the supplier's behavioral uncertainty decreases.

P4: *Indirect links through a central third-organization provide the buyer a network governance structure to manage the focal supplier's behavioral uncertainty caused by agency problems.*

1.3.5 Caveat Emptor: Risks of Using Indirect Links to Overcome Agency Problems

Indirect links, as we have argued, are instrumental in enabling information exchange and mutual monitoring, changing the power distribution between the buyer and supplier, and facilitating network governance. However, there are risks. First, indirect links create another principal-agent relationship between the buyer and the third node. That means, the buyer may end up having to deal with the agency problem it was trying to overcome with its supplier. If the principal-agent relationship with the third node incurs high agency costs, the buyer might end up with higher total agency costs. For example, a buyer could have to invest a lot of effort to coordinate communication and supply activities of two competing suppliers, though the original intention could be to create the mutual monitoring mechanism between the two suppliers.

In addition, just as the buyer could gain power from the indirect links, the supplier could use the same approach to increase its own power. For example, the supplier could intentionally connect to the buyer's customer or form a coalition with another supplier. In either case, the changes in power distribution, enabled by introducing the indirect links, would be favorable for the supplier. The situation can be worse if the

two suppliers collude through the indirect links (Bajari and Summers, 2002; Gupta, 2002). For example, if the buyer works with another supplier to intervene in the current buyer-supplier dyad, the new supplier can turn against the buyer and have a “side contract” with the incumbent supplier (Mookherjee and Tsumagari, 2004). In practice, the buyer may need to intentionally avoid sharing the name of one supplier with another to avoid such problems. Therefore, the use of indirect links needs to be carefully implemented and managed.

Furthermore, the buyer is likely to face resistance from the supplier. The supplier would resist disclosing its suppliers or customer information to the buyer in order to avoid losing power. Directed sourcing, where an organization’s sourcing decision is directed by another organization, has been used by leading companies, such as Apple, Dell, HP, Honda, IBM, LG electronics, and Toyota, to strengthen their own ability to innovate, cut costs, and manage risk (Choi and Linton, 2011). Honda of America, for example, often contracts directly with key second- and third-tier suppliers and then asks its top-tier suppliers to receive the contracted parts. In this case, the top-tier suppliers manage the quality and delivery, while Honda manages costs and technologies (Choi and Hong, 2002; Choi and Linton, 2011). Although this practice is beneficial to Honda, its top-tier suppliers may suffer from losing control over the lower-tier suppliers because these lower-tier suppliers “are usually ‘more loyal’ to the final assembler than to the top-tier supplier, and in turn, they would be less responsive to the top-tier requests regarding quality or delivery” (Choi and Hong, 2002, p.486). In this case, the supplier will try to avoid the situation by holding more information from the buyer, and thus, will further increase the level of information asymmetry and the agency cost.

1.4 Discussion

We extend the context of agency theory beyond the dyadic context. We propose the use of a third node through which indirect links are established and argue that a buyer can decrease agency costs through indirect links. We identify four positions involving the third node that can allow for such links: the supplier’s supplier, supplier’s customer, buyer’s other supplier, and buyer’s customer. Four propositions are formulated by arguing how the indirect links enable effects of information exchange, mutual monitoring, power redistribution, and network governance, all of which can reduce agency costs. We also discuss the limitation of the indirect links approach in terms of how the new third node can interfere with the original intent and how the supplier could resist. In conclusion, we believe that the indirect links can clearly affect the existing principal-agent dynamics in the buyer-supplier dyad. We have tried to articulate how such indirect links may help address agency problems.

We contribute to the literature in three ways. First, we extend agency theory beyond the principal-agent dyad. As such, we offer a novel and broader perspective to inform and address agency problems and we demonstrate how it can be applied in the buyer-supplier context. Second, with this new perspective, we identify an alternative way to overcome agency problems, complementary to traditional approaches such as monitoring and incentives. Just as there are different practices that can serve the purpose of monitoring and incentivizing, there can be more than one set of indirect links (i.e., links go through different actors in the common network) of the focal dyad that can overcome the agency problem. By looking beyond the dyad, scholars and practitioners are exposed to a larger view—the network. In particular, we identify four positions of the third node that creates the indirect link. In addition, four different mechanisms that can reduce agency cost are identified—they are informa-

tion exchange, mutual monitoring, power reconfiguration, and network governance. Therefore, the selection of the indirect links should be based on the nature of the problem and the benefits these links can provide.

Future research should empirically examine the propositions developed in this paper. One should be mindful of the sensitivity of the topic (i.e., the third node may be reluctant since it is outside the principal-agent dyad) and the fact that the unit of analysis is triad (i.e. it may be difficult collect data from all three matching partners). Given these observations, three empirical methods might be considered. First, systematic case studies can be conducted to further refine the propositions, where new properties and the interaction between the properties can be identified. Researchers may have to look for triadic relational settings first and then try to see which type of relational arrangements they fall into among the ones proposed here. Second, scenario-based experiments can be conducted to mitigate social desirability issues and simplify the network dynamic into a more structured context. Third, researchers could employ computer-based simulation, including agent-based modeling approaches, to model the behavior of the three nodes under differing scenarios. In addition to empirical research, analytical models can be developed to further quantify the impact of the indirect links on the principal's agency cost reduction. A principal-agent modeling framework may also be adopted to examine the incentive issues among the different parties involved in a supply network beyond the dyadic context.

In sum, by extending agency theory beyond the dyadic context, we are able to identify a new way to address agency problems (i.e., through indirect links). Given the different nature of each agency problem, we should not expect a single best solution. Pragmatically, the question of how to select the appropriate indirect link(s) will likely be challenging. Managers will have to develop this understanding over time. In addition, after selection, the question of how to manage these indirect links

becomes relevant. We hope that we have brought to the fore the importance of moving beyond the dyad when considering agency problems and new ways to overcome them by incorporating the third firm.

Chapter 2

ADDRESSING SUPPLIER OPPORTUNISM BEYOND THE DYAD: THE EFFECT OF NETWORK GOVERNANCE

Abstract

Supplier opportunism is a common issue in supply chain management and has drawn a lot of attention in literature. While the literature has mainly focused on the effect of governance mechanisms that are within the buyer-supplier dyad, the effect of network governance mechanism on the supplier opportunism is largely overlooked. To understand the effect of network governance mechanism, two scenario-based role play experiments were conducted using 312 managers with relevant experience and MBA students. Structural Equation Models for experimental design was used for analysis, and the results show that our hypothesized model is partially supported. In particular, the findings in Study 1 show that the buyer's level of embeddedness in the supplier's network reduces the supplier's opportunistic behavioral intention, and the effect is partially mediated by the supplier's negative affection prediction, but not mediated by the supplier's predictions of the buyer's reactions. The finding in Study 2 shows that the buyer is more likely to engage in negative word-of-mouth (WOM) activities and decrease its commitment to the supplier if the supplier's performance is lower than expected, which presumably is an outcome of the supplier's opportunism. Our study expands agency theory beyond the buyer-supplier dyad and investigates how network governance curves supplier behavioral intention through multiple mechanisms: dyadic and. network-level effects, as well as economic and. psychological effects. In addition, this research provides managerial implications to both the buying and supplying sides

and to both business-to-business (B2B) and business-to-consumer (B2C) transactions.

2.1 Introduction

Supplier opportunism is commonly assumed in transactions and has received significant attention in research in supply chain management (Morgan et al., 2007; Provan and Skinner, 1989; Wallenburg and Schäffler, 2014). Both Agency Theory and Transaction-Cost Economics (TCE) suggest that governance mechanisms, such as monitoring, providing incentives, vertical integration, and long-term relationships, are needed to curve the supplier’s opportunistic behaviors. Yet, all these governance mechanisms are confined within the buyer-supplier dyad and may not always be effective. For example, LGE had difficulties working with Qualcomm, its CDMA-chip supplier. Despite their long-term relationship, the two companies were constantly jockeying for leverage (Choi and Linton, 2011). LGE worked hard to solve this issue by adding incentive terms and by building a close relationship with Qualcomm. Yet, the problem persisted. Interestingly, once LGE moved beyond the dyad by forging an informal relationship with TSMC, its second-tier supplier that manufactures the CDMA-chips for Qualcomm, it discovered that Qualcomm became more accommodating.

This example illustrates the effect of network governance mechanism, an informal mechanism that works complimentary to the formal mechanisms within the dyad (Jones et al., 1997; Tachizawa and Wong, 2015). By looking beyond the buyer-supplier dyad, network governance theory suggests that the fact that the buyer and supplier is embedded in a larger inter-organizational network could curve the supplier’s behavior (Jones et al., 1997). In particular, network governance theory suggests that structural embeddedness could curve the supplier’s behavior through social mechanisms, such as macroculture, collective sanctions, and reputation. And literature generally believes

that these social mechanisms evolve in a relatively long period of time and are considered as evolutionary (Axelrod, 1986, 1987; Nowak and Sigmund, 1998; Burtsev and Turchin, 2006; Boyd et al., 2003). However, the example of LGE didn't go through an evolutionary process but the effect is instantaneous. That is, soon after LGE's chief procurement officer visited TSMC, Qualcomm became more accommodating. Therefore, while the effect of network governance had been proposed two decades ago and has been supported by some empirical evidence (Choi et al., 2002; Kim et al., 2011; Wu and Choi, 2005; Wu et al., 2010), the underlying mechanism of the effect is largely unknown. In particular, several unanswered questions are: If the effect of embeddedness does not go through the effect of social mechanisms, how can it curve the supplier's opportunistic behavior? Must the buyer react to the supplier's opportunism to enable the network governance mechanism? And when, if at all, will the buyer would react to supplier opportunism?

Social psychology theories, as an alternative to the evolutionary view, could potentially explain the instantaneous effect of network governance because these theories primarily explain how people's thoughts, feelings, and behavior are affected by the actual, imagined, or implied presence of others (Allport, 1985). Therefore, we incorporated social psychology theories to answer the above mentioned questions. In this chapter, two studies were conducted using the scenario-based role-play experiments. In particular, Study 1 was designed from the supplier's perspective to examine whether and how dyadic and network governance mechanisms affect the supplier's opportunistic behavioral intention through the supplier's perceived costs for being opportunistic, and Study 2 was designed from the buyer's perspective to examine when, if at all, a buyer would react to supplier opportunism. The findings in Study 1 show that the supplier's opportunistic behavioral intention decreases as the buyer's level of embeddedness increases (the effect of network governance mech-

anism), while supplier's opportunistic behavioral intention does not differ among the three dyadic governance mechanisms, namely a muscular, benign or credible relationship between the buyer and the supplier. In addition, the effect of the network governance mechanism on supplier's opportunistic behavioral intention is mediated by the supplier's negative affection prediction but not by the supplier's predictions of the buyer's reaction. However, the finding in Study 2 shows that the buyer is more likely to engage in negative word-of-mouth (WOM) activities and decrease its commitment to the supplier if the supplier's performance is lower than expected, an outcome of a possible supplier opportunism. Our study contributes to the literature by expanding Agency Theory beyond the buyer-supplier dyad and by investigating how network governance curves supplier behavioral intention through multiple mechanisms: dyadic- and network-level effects, as well as economic and psychological effects. In addition, our findings provide managerial implications that network governance mechanism could be effective through the supplier's perceived internal loss and that, although the suppliers do not consider the buyer's reaction to the opportunistic behavior when they are making decisions, the buyer's reaction is very likely to be noticed and to negatively affect the supplier's future business with the buyer as well as the supplier's reputation to its potential customers.

In Chapter 2, we first provide an overview of the theoretical foundation for this research in section 2.2. Next, we develop Study 1 in section 2.3; we first present the constructs in the hypothesized model and hypothesize their interrelationships, then discuss the methodology, including participants, quality control for careless responses, the procedure of experiment, and validity checks, and finally present the analysis and discuss the results of Study 1. We then develop Study 2 in section 2.4 which is structured the same as Study 1. Finally, we discuss the results from both studies, highlight the theoretical and managerial implications, and identify potential future

research directions in section 2.5.

2.2 Theoretical Foundation

2.2.1 An Overview of Supplier Opportunism

Supplier opportunism, defined as “self-interest seeking with guile” (Williamson, 1993, p.97), is a key construct in exchange theory and has received significant attention in research in supply chain management (Morgan et al., 2007; Provan and Skinner, 1989; Wallenburg and Schäffler, 2014), marketing channel management (Crosno and Dahlstrom, 2008; Ishida, 2007; Jap and Anderson, 2003; Seggie et al., 2013; Stump and Heide, 1996; Wang et al., 2013), and strategic alliances (Lui and Ngo, 2004; Parkhe, 1993; Srinivasan and Brush, 2006). There are different types of supplier opportunism such as adverse selection, shirking, refusal to adapt, breach of contract, etc. The literature suggests two ways to categorize opportunism: *ex ante* vs. *ex post*, and *passive* vs. *active*. *Ex ante* vs. *ex post* opportunism differ based on the time when the opportunistic behavior occurs. A supplier can engage in opportunism before the transaction (i.e., *ex ante* opportunism) such as the misrepresentations of the supplier’s ability during the supplier selection process (i.e., adverse selection), or after the transaction is in process (i.e., *ex post* opportunism) such as failing to fulfill promises or obligations upon agreement by shirking (i.e., moral hazard) or using a sub-optimal material. In addition, Wathne and Heide (2000) identified another way to categorize of opportunistic behaviors, namely, *active* and *passive*, “depending on whether a particular behavior (or lack thereof) takes place” (p. 41). For example, shirking (lack of effort) and hiding information (lack of communication) are considered as *passive* opportunism, while deliberately misrepresenting facts (Shell, 1991) and engaging in forbidden acts are considered as *active* opportunism (Ishida, 2007).

Because ex ante opportunism generally occurs before the buyer-supplier relationship forms and passive opportunism could be the result of ignorance, we focus on the supplier's ex post and active opportunism, which is common and generally associated with higher costs in a buyer-supplier relationship.

2.2.2 Governance Mechanisms and Supplier Opportunism

Dyadic Governance Mechanisms

Governance mechanisms are “tools that are used to establish and structure exchange relationships” (Brown et al., 2000, p.52) and are needed to curve the opportunistic behaviors (Eisenhardt, 1989; Williamson, 1993, 1998). According to Agency Theory, the buying firm should monitor and/or provide incentives to the supplier to decrease the level of information asymmetry and goal incongruence which reduce supplier opportunism (Eisenhardt, 1989). In supply chain literature, buyers could use market-based incentives (e.g., increased volumes of present business and priority consideration for future business) (Giunipero, 1990; Krause et al., 2000; Monczka et al., 1993) or relationship-based incentives (e.g., strategic partnership and supplier development programs) (Choi and Wu, 2009; Dionisis et al., 2002; Kwon and Suh, 2004) to reduce the goal incongruence. In addition, buyers could also directly involve themselves in the supplier development effort and dedicate personnel temporarily to the supplier (Krause et al., 2000; Monczka et al., 1993; Newman and Rhee, 1990) and adopt inter-organizational information systems (e.g. EDI systems) to monitor the supplier and reduce the level of information asymmetry (Andersen and Buvik, 2001; Carr and Pearson, 2002; Guan and Rehme, 2012; Holland et al., 1992).

However, agency theory predicts that monitoring inefficiency and a lack of perfect incentives are the two main reasons for supplier opportunism. While the incentive

approach transfers risks to the agent who are generally more risk averse (Eisenhardt, 1989; Lane et al., 1998; Tosi et al., 1997; Waterman and Meier, 1998), the effect of monitoring is threatened due to measurement imperfection, multiple tasks in agency relations, ex ante causal ambiguity and reactant caused by offending the agent's sense of autonomy (Baker, 1992; Brehm, 1966; Heide et al., 2007; Jacobides and Croson, 2001; Sharma, 1997; Tosi et al., 1997; Williamson, 1975). Therefore, buyers search for additional governance mechanisms to decrease supplier opportunism.

TCE identifies market, hierarchy, or a hybrid of the two as alternative governance mechanisms. In essence, based on asset specificity, uncertainty and frequency, an organization would choose a governance mechanism that minimizes opportunism and consequently transaction costs. While early TCE suggests that the buyer could exit from the relationship via market exchange or vertical integration in response to supplier opportunism (Williamson, 1975, 1979, 1998), neither pure market exchange nor complete vertical integration is common in buyer-supplier relationships. More recent development of TCE suggests that the buyer could choose the hybrid form of governance as an alternative to market and hierarchy (Williamson, 1993). There are three forms of hybrid governance, namely muscular, benign, and credible, which differ by the dynamics between the buyer and supplier, how the buyer uses power and trust, and how the buyer react to the supplier's behavior (Williamson, 2008). All three forms are considered dyadic governance mechanisms that could reduce supplier opportunism.

Network Governance Mechanisms

While dyadic governance mechanisms dominate supply chain management literature, emerging research also suggests the importance of embeddedness, the fact that the buyer-supplier dyad does not exist in isolation but is embedded in a larger net-

work (Choi and Kim, 2008; Granovetter, 1985). Because of the embeddedness, the network member’s actions and the outcomes are affected not only by the dyadic relations, but also by the other network members’ actions, relations beyond the dyad, and the structure of the overall network of relations (Granovetter, 1992, p. 33). According to the network governance theory, network governance is defined as implicit and socially-binding contracts based on which a network of organizations creates products or services (Jones et al., 1997). Network governance, as alternatives to those dyadic and formal governance mechanisms, works as an informal governance mechanism that could safeguard exchanges and reduce the level of supplier opportunism (Jones et al., 1997).

First, embeddedness enables information sharing (Granovetter, 1985, 1992). According to Granovetter (1985; 1992), network embeddedness “is a function of how many participants interact with one another, how likely future interactions are among participants, and how likely participants are to talk about these interactions” (Jones et al., 1997, p. 924). In other words, as the level of embeddedness increases, the actors are more likely and have greater interest in obtaining and sharing the information about one another (Burt, 1992). Due to information sharing enabled by embeddedness, network governance can resolve exchange problems through the social mechanism, such as collective sanctions and reputation. Collective sanctions reduce behavioral uncertainty by demonstrating the consequences of violating norms and values, increasing the costs of opportunism, and decreasing the costs of monitoring to any one party (Jones et al., 1997). In addition, reputation reduces behavioral uncertainty because a favorable reputation is notoriously difficult to develop (Flanagan and O’shaughnessy, 2005) and usually requires significant long-term investment (Doney and Cannon, 1997) so that firms are reluctant to jeopardize their reputations and develop strategies to avoid reputation threats and damages (Telser, 1980). As

the buyer's embeddedness in the supplier's network increases, there is a better chance that any of the supplier's opportunistic behavior will be known to the market, which also increases the costs of opportunism (Granovetter, 1985).

Both conceptual argument (Choi and Kim, 2008; Pirson and Turnbull, 2011; Provan, 1993; Provan and Kenis, 2008) and empirical evidence (Yoon and Hyun, 2010; Foster et al., 2011) imply that network governance, the effect of embeddedness, reduces supplier opportunism through an evolutionary process in that opportunistic actors will be punished, through collective sanction (Boyd et al., 2003; Axelrod, 1986) or through reputation damage (Nowak and May, 1992; Nowak and Sigmund, 1998), and exit the market eventually so that only non-opportunistic actors (also called cooperative actors) survive. Yet, the above mentioned LGE example demonstrates that the effect of embeddedness may not necessarily be evolutionary, which takes a long period of time. Instead, the example shows that the effect of embeddedness could be instantaneous in that no collective sanction or reputation damage occurred before the supplier changed its behavior. Therefore, we examine the antecedence of opportunistic behaviors from social psychology literature to understand the perceptual mechanism of network governance, as an alternative to the social mechanisms.

2.2.3 Decision Making of an Opportunistic Behavior

A homo economicus view assumes that individuals are self-interested and are utility maximizers (Roth et al., 1991; Mazar et al., 2008; Henrich et al., 2001). According to this perspective, people would consider three aspects in making a decision on whether to behave opportunistically: (1) the magnitude of rewards for being opportunistic, (2) the probability of being caught, and (3) the magnitude of punishment if caught. These three inputs provide the basis for people to reach a decision on whether to perform an opportunistic behavior in order to maximize their interests

(Hechter, 1990; Mazar et al., 2008; Lewicki, 1983). For example, when a person faces the decision of whether to rob a gas station, the three aspects to consider are: (1) the expected amount of cash gained from robbing the place, (2) the probability of being caught, (3) and the magnitude of punishment if caught (Mazar et al., 2008). Among the three components of the antecedence, the punishment perceived by the individual could be generated from external sources, such as financial punishment from the court and relational damage from a buyer, and also from internal sources such as negative feelings. In particular, psychological research has shown that people internalize the norms and values of their society (Henrich et al., 2001; Campbell, 1964), which serve as an internal benchmark that guide their decisions. For example, compliance with the internal values will provide positive psychological rewards, while noncompliance leads to negative psychological rewards (i.e., negative feelings). In this case, for someone who passes a gas station, his or her decision on whether to rob the place is also influenced by the magnitude of negative feelings generated from the act of robbing (Mazar et al., 2008). Therefore, as a person makes decision on whether to behave opportunistically, not only should she consider the external costs, but also the internal costs. On the other hand, these punishments generated from either external or internal sources are the decision makers perceptions before the opportunistic behavior occurs (if it occurs at all), not the real punishment incurred after an opportunistic behavior. While the former is commonly considered in supply chain management and economic literature (Henrich et al., 2001), the latter is largely overlooked.

In sum, the effect of network governance on supplier opportunism lacks understanding, i.e., whether the mechanism is evolutionary as suggested in the theory or instantaneous as observed in real world examples. To close this research gap, we develop two studies to investigate whether the effect of network governance requires

the buyer’s reactions, and when, if at all, the buyer would react to a scenario for potential opportunism. In the next two sections, we first develop hypotheses, describe the procedure of the scenario-based behavioral experiments, and discuss the analysis and results.

2.3 Study 1

The purpose for Study 1 is to test the effect of network and dyadic governance mechanisms on the supplier opportunism. While supplier opportunism is an organizational-level action, such action is decided by one or more individuals acting as agents for the supplier (Eisenhardt, 1989). Also, since we are using scenarios to manipulate factors such as the level of embeddedness and the buyer’s dyadic governance approach, it is important to understand how an individual’s perceptions are affected by these factors and thus change one’s behavioral intention. Therefore, we incorporated social psychology theories which primarily explain how people’s thoughts, feelings, and behavior are affected by the actual, imagined, or implied presence of others (Allport, 1985). Since our studies rely on the participant’s imagination of the presence of the buyer, the supplier, or the other members in the hypothetical network, social psychology provides an overarching structure for our hypothesized model. In particular, both studies follow the structure that the manipulated factors (e.g., the level of embeddedness) affect the individual’s perceptions and feelings which affect their behavioral intention (Allport, 1985). The development of the hypotheses for Study 1 is described in details in the following section.

2.3.1 Development of Hypotheses

In Study 1, we develop and test hypotheses from the supplier’s perspective. In particular, we investigate the effects of dyadic and network governance mechanisms on

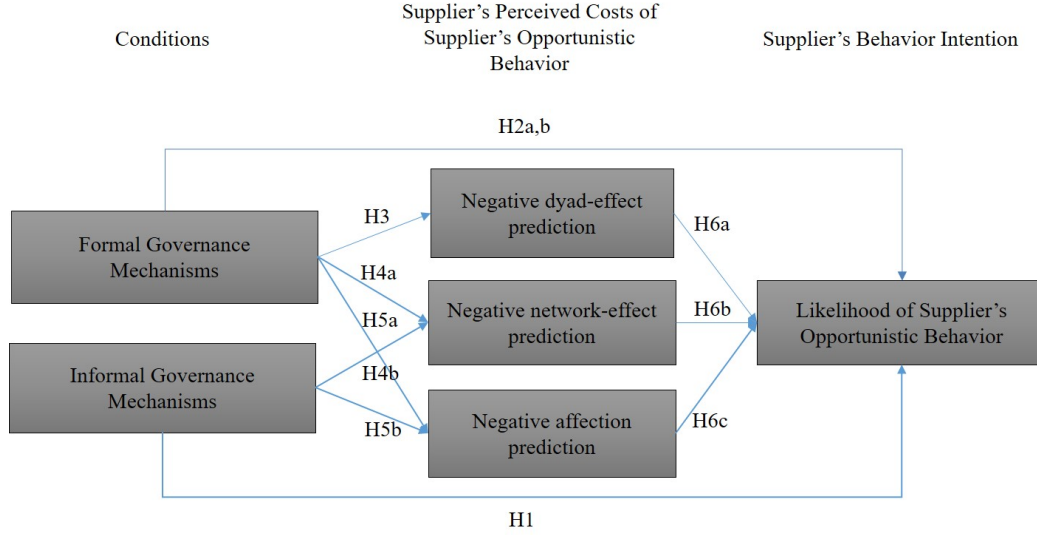


Figure 2.1: Hypothesized Model for Study 1

reducing the supplier's opportunistic behavioral intention. We also examined whether these effects are mediated through the supplier's predictions of the consequences of opportunistic behavior. The hypothesized model is shown in Figure 2.1.

First, we hypothesize that network governance mechanisms, i.e., the embeddedness, have a direct effect on the supplier's opportunistic behavior. According to the network governance theory, which integrated extended TCE to the network level, network governance serves as an informal and social contract that coordinates and safeguards exchanges through the effect of embeddedness (Jones et al., 1997, p.914).

The network governance theory has received large attention since it was developed two decades ago, both conceptual discussion and empirical evidence has demonstrated the effectiveness of embeddedness (Choi and Kim, 2008; Pirson and Turnbull, 2011; Provan, 1993; Provan and Kenis, 2008). For example, Yoon and Hyun (2010) drew empirical observations from research on East Asian network governance and found that these informal mechanisms reinforce, substitute, or undermine formal mechanisms, and the degree of these effects depends on institutional environments. In addition, Foster et al. (2011) conducted an inductive case-based research to study

gatekeeper roles in creative industries and found that gatekeepers (i.e. the buyers) maintain arm's length relationships with many bands (i.e. the suppliers) but are embedded in dense information-sharing networks with each other. This finding provides evidence for network governance theory in that "ties among buyers can reduce uncertainty by spreading information about opportunistic actors and producer quality while also diffusing cultural norms and practices" (p. 261). Finally, Choi and Kim (2008) proposed that buyers are likely to perform better in supplier management if they have a good understanding of the supplier's structural embeddedness.

In sum, as the buyer's level of embeddedness in the supplier's network increases, the network governance mechanism is enabled to safeguard the transaction. Therefore, if the buyer is highly embedded in the supplier's network, the supplier is less likely to engage in opportunistic behavior.

H1: The supplier's opportunistic behavior intention is lower if the buyer's level of embeddedness in the supplier's network is higher than if it is lower.

In addition, according to the recent development of TCE (Williamson, 2008), there are three types of the hybrid form of governance, muscular, benign, and credible, all of which are considered as dyad governance mechanisms that could reduce supplier opportunistic behavior. In particular, the muscular governance approach assumes that the buyer, usually larger, deals with suppliers "in a peremptory way" (Williamson, 2008, p. 10). Buyers that employ a muscular approach often provide suppliers with rigid specifications and request the supplier to offer the lowest price based on these specifications. Little if any collaboration exists under a muscular approach. "Muscular buyers not only use their suppliers, but they often 'use-up' their suppliers and discard them" (Williamson, 2008, p. 10). The muscular governance approach reduces the supplier opportunism because the buyer has power over the supplier and does not

hesitate to use it. If anything goes wrong, the buyer is likely to transfer the financial burden to the supplier. Because the supplier will bear any consequences of its opportunistic behavior, the level of supplier opportunism is low under the muscular approach. Yet, this approach is considered myopic and inefficient because suppliers would often “ask the buyer to provide safeguards, thereby to mitigate the risks, or they will increase their price to reflect the added risk that they are being asked to assume” (Williamson, 2008, p. 10).

The benign governance approach, at the other extreme, assumes that the buyer naively trusts the supplier and uses cooperation to deal with any contingencies. In other words, “trust supplants power as the key concept” (Williamson, 2008, p. 10). This approach reduces supplier opportunism due to the collaborative spirit that the parties are always seeking for mutual benefits. However, this approach too is myopic, because if the payoff of opportunism exceeds “the discounted value of continuing the exchange relationship, defection from the spirit of the contract can be projected” (Williamson, 2008, p. 10).

The credible governance approach “differs both from benign contracting, in that it is hardheaded (hence does not project benign behavior when outliers appear), and from muscular contracting, in that it is not mean spirited” (Williamson, 2008, p. 10). A long term orientation and mutual gains also exist, but trust is tempered by a recognition that the supplier might be tempted to act opportunistically. The credible governance approach reduces supplier opportunism by considering potential hazards and by developing credible commitments proactively into the contractual design to mitigate these potential hazards.

While all three dyadic governance mechanisms reduce the supplier opportunism, among the three dyadic governance mechanisms, the credible mechanism is most effective because of the balance in using both power and trust. The muscular mech-

anism simply transfers risk to the supplier which causes inefficiency and the benign mechanism relies too much on the “cooperative spirit” and creates room for supplier opportunism (Wallenburg and Schäffler, 2014; Williamson, 2008; Zipkin, 2012). Therefore, if the dyadic governance mechanism adopted by the buyer is credible, the supplier will be less likely to engage in opportunistic behavior than with the muscular or benign mechanisms.

H2a: *The supplier’s opportunistic behavior intention is lower if the dyadic governance mechanism adopted by the buyer is credible than if it is muscular.*

H2b: *The supplier’s opportunistic behavior intention is lower if the dyadic governance mechanism adopted by the buyer is credible than if it is benign.*

According to Jones et al. (1997), network governance can resolve exchange problems through the social mechanism of collective sanctions and reputation. Collective sanctions reduce behavioral uncertainty by demonstrating the consequences of violating norms and values, increasing the costs of opportunism, and decreasing the costs of monitoring to any one party (Jones et al., 1997). For example, Boyd et al. (2003) examined the effect of altruistic punishment in an n-player game setting and found that group members maintain a higher level of cooperation even as the group size increases and concluded that group selection is more effective at maintaining altruistic punishment than altruistic cooperation. In addition, the increase of network embeddedness also increases the ease for the supplier’s reputation to be channeled. In general, a firm’s reputation refers to the perceptions by a firm’s audience (e.g., the firm’s customers) about how well the firm can provide value compared with its competitors (Doney and Cannon, 1997; Hess Jr, 2008; Philippe and Durand, 2011). Reputation also develops over a long period of time. For example, Nowak and Sigmund (1998) proposed and found evidence that reciprocal altruism not only occurs

in a direct reciprocity, but could also occur even when the likelihood of repeated interaction is very low if reputation, referred as an “image” score, could be obtained.

While both collective sanctions and reputation, involve a relatively long and evolutionary process (Axelrod, 1986, 1987), real-world examples demonstrate that the effect of embeddedness may not have to go through an evolutionary process but could be instantaneous. In other words, when people are making decisions on whether to be opportunistic, before the opportunistic behavior and any consequences occur, they already are perceiving the benefits and costs so that they could choose not to act opportunistically if their perceived costs are higher than the perceived benefit.

Therefore, we hypothesize that the effect of network governance mechanism on supplier opportunism, the mediating effect of supplier’s perceived costs for being opportunistic. Two perceived external costs, namely negative dyad-effect prediction and negative network-effect prediction, and one perceived internal cost, namely negative affection prediction, are identified. The negative dyad-effect prediction is defined as a person predicts a negative effect on current or future interactions with the focal buyer resulting from a person’s behavior. Since the negative dyad-effect prediction only reflects the interaction within the dyad, we hypothesize that it will only be affected by dyadic governance mechanism used by the buyer, but not be the level of embeddedness. Predicting the negative dyad-effect is considered as a perspective taking activity which is an intrapsychic process of imagining another’s thoughts, feelings, and actions from that person’s point of view (Williams, 2007). This process enables individuals to comprehend and predicts another’s behavior based on their understanding of previous interactions (Davis, 1989). Among the three dyadic governance mechanisms, the benign relationship will have a smaller impact on negative dyad-effect prediction than muscular and credible, because the buyers who adopt this dyadic mechanism rely on the cooperative spirit and they trust naively. If the buyer

is considered to naively trust the supplier and has been less active in reacting to the supplier's opportunistic behavior in previous interactions, the supplier would perceive a lower level of negative dyad-effect. Therefore, we have

H3: *The supplier's negative dyad-effect prediction is lower if the dyadic governance mechanism adopted by the buyer is benign than if it is credible.*

The second perceived external cost is negative network-effect prediction, which is defined as a person predicting a negative effect on its current or future interactions with firms other than the focal buyer resulting from the person's behavior. Similarly, the supplier also needs to engage a perspective-taking process based on its understanding of the buyer. Based on its experience with the buyer, if the buyer adopts a benign mechanism, the supplier will predict a lower level of negative network effect than if the buyer adopts a muscular or credible mechanism, because the buyer is considered passive, it is less likely that the buyer will share the information with the other network members.

In addition, the supplier's negative network-effect prediction is not only affected by its interaction with the buyer, but also by how well the buyer is connected in the network, i.e., the level of embeddedness. As the buyer's embeddedness in the supplier's network increases, the buyers would have more opportunities to share information with other network members so that the probability for the supplier's opportunistic behavior to be known by others will increase (Granovetter, 1985). Therefore, if the supplier understands that the buyer is well connected to others in the network, it will predict a higher negative network effect.

H4a: *The supplier's negative network-effect prediction is lower if the dyadic governance mechanism adopted by the buyer is benign than if it is credible.*

H4b: *The supplier's negative network-effect prediction is higher if the buyer's level*

of embeddedness is high than if it is low.

The third type of perceived costs is the negative affection prediction, which is an internal costs, defined as a person predicting negative feelings, such as guilty or anxiety, after certain behavior. Social psychology literature has shown people have an internal benchmark to evaluate self and other's behavior (Henrich et al., 2001), and such evaluation will affect the way people view and perceive themselves and others (Aronson, 1969; Baumeister et al., 1998; Bem, 1972). For example, if people fail to comply with their internal standards for honesty, they will need to negatively update their view of self. As people generally want to maintain a positive view of self (Greenwald, 1980; Griffin and Ross, 1991; Sanitioso et al., 1990), this contradiction will cause negative affection, a source of internal costs. In particular, people feel guilty when they engage in unethical behavior and feel anxious about being caught for such behavior (DePalma et al., 1995; Eisenberg, 2000; Ruedy et al., 2013). In addition, the magnitude of negative affection differs in different situations. For example, Mazar et al. (2008) conducted experiments and found that people use various mechanisms (e.g., categorization and attention to standard) to allow them to engage in a limited amount of dishonesty while retaining positive views of themselves. Furthermore, while people have negative affective prediction before an unethical behavior, when the outcome of dishonesty is associated with feelings of self-satisfaction, people experience positive affective consequences after the actual unethical behavior (Ruedy et al., 2013). In addition, research has found that people behave more dishonestly when rejected due to emotional factors such as a desire for revenge (Baumeister et al., 2007; Van Der Zee et al., 2016)

Therefore, among the three dyadic governance mechanisms, a muscular relationship is adversarial and intense. The buyer takes advantage of the suppliers and "being mean" becomes a relational norm in such relationships. Since being opportunistic

falls into the same spirit of the relational norm, in this case, the supplier either adjusts her internal benchmark to fit the relational norm or does not evaluate herself negatively when she is opportunistic due to the rejection of efforts from a muscular buyer. In addition, if the buyer's embeddedness level is high, the supplier would predict a higher likelihood for others to learn of her opportunistic behavior, which is likely to cause a higher level of anxiety when she considers acting opportunistically. Therefore, we have:

H5a: *The supplier's negative affection prediction is lower if the dyadic governance mechanism adopted by the buyer is muscular than if it is credible.*

H5b: *The supplier's negative affection prediction is higher if the buyer's level of embeddedness is high than if it is low.*

Finally, we hypothesize the negative association between the three perceived costs and the supplier's opportunistic behavioral intention. In particular, both the negative dyadic- and network-effect predictions are considered as the supplier's prediction of the buyer's reactions against the supplier's opportunistic behavior. As the supplier predicts higher levels of the buyer's negative reaction, the perceived payoff for the potential opportunistic behavior decreases. Negative affection prediction, the third type of perceived costs, is the supplier's individual feelings for engaging in the opportunistic behavior. The prospect of experiencing these negative feelings will also curb unethical behavior because people generally want to maintain a positive view of self and generally avoid negative feelings (Baumeister et al., 2007). Therefore, as a supplier making the decision on whether to act opportunistically, if its perceived benefits and the likelihood of being caught hold constant, the higher the perceived costs are, the less likely the supplier would engage in opportunism.

Therefore, we have:

H6a: *The supplier's opportunistic behavioral intention is lower if the supplier's negative dyadic-effect prediction is high.*

H6b: *The supplier's opportunistic behavioral intention is lower if the supplier's negative network-effect prediction is high.*

H6c: *The supplier's opportunistic behavioral intention is lower if the supplier's negative affection prediction is high.*

2.3.2 Methodology

To test these hypotheses and ensure that causal inferences can be made regarding the factors of interest, we conducted a scenario-based role-play experiment with practicing managers (Tangpong et al., 2010; Kull et al., 2014; Rungtusanatham et al., 2011). A scenario-based experiment was preferred because it allows the manipulation of factors to be described in different scenarios. Such an experiment is most appropriate for studying practices or strategies that are not yet commonly adopted or for studying unethical behaviors (Rungtusanatham et al., 2011). Since the effect of network governance mechanism is a relatively new concept to most managers and supplier opportunism is considered deceptive, a scenario-based role-play approach would outperform alternative methodology, such as using a survey or secondary data.

Participants

The participants were practitioners and part-time MBA students at a major research university. Initially, 965 people (787 practitioners and 78 MBA students) participated the study (including both Studies 1 and 2), among whom 349 completed the experiment (either Study 1 or Study 2) and the rest were dropped from the study due to lack of relative experience or failure to pass the quality control thresholds. For

Study 1, 172 participants completed the experiment (151 practitioners and 21 MBA students) using an online survey. The literature shows that MBA students and practitioners share similar decision-making processes (Heisler and Gemmill, 1978). Unlike survey studies, the mixing of participants is less an issue for our study because the experiment is based on a hypothetical scenario, so whether a participant is currently employed is not a concern as long as the participant has some related experience to help them make decisions in the experiment. The practitioners were recruited via a Qualtrics panel for a small monetary incentives, and the MBA students were recruited in class for a raffle prize. Among the 172 responses, 16 cases were identified as multivariate outliers in the Mahalanobis distance analysis (Meade and Craig, 2012) and thus were dropped from analysis. Therefore, a final sample of 156 cases were used for analysis.

Our experimental design follows recommendations by Rungtusanatham et al. (2011). Specifically, our pre-design stage assured alignment with previous studies on supplier's opportunistic behavior (Kollock, 1994; Parkhe, 1993) and buyer-supplier relationship (Tangpong et al., 2014). Also, in our post-design stage, a pretest was conducted with 13 practitioners from a local ISM meeting to ensure that responding managers would have no difficulty understanding the meaning of the related constructs. The feedback from pretest confirmed that the issue is quite common and relevant, which provided evidence for external validity. Three rounds of pilot tests were then conducted with both undergraduate and graduate students (215, 85, and 103 participants, respectively) from a large research university to refine the experimental design, improve the measurement model, and ensure manipulation validity (Rungtusanatham et al., 2011).

Quality control for careless responses

Careless responses are a critical concern for survey and scenario-based experimental studies because the validity of the study largely depends on how well the participants understand the scenario presented and the questions asked. A series of practices were adopted to identify careless responses suggested by Meade and Craig (2012). First, we identified the median of time elapsed in the pilot tests and used one third of the median as the threshold for identifying participants who rushed through the study. Second, we conducted a quiz to test the participants' understanding of the reading material and the experiment would continue only if the participants answered both quiz questions correctly. Third, we also inserted items such as "Please select 'Strongly Disagree' for this statement" in the study. Failure to answer these items would cause the study to cease immediately and the responses to be dropped. After all responses were collected, a post hoc screening was conducted using Mahalanobis distance approach which considers the pattern of responses across a series of items to identify multivariate outliers. Sixteen responses were removed as a result of the outliers analysis.

Procedure of Experiment

During the experiment, managers were first presented with a consent letter as prescribed by institutional review board (IRB) requirements for human-subject experiments. The general nature and intent of the experiment were given (e.g., to improve understanding of buyer-supplier relationship) but not the specific research questions to avoid giving cues. Next, participants were asked about their current and previous working experience using a multiple-choice question. Only the participants who claimed to have relevant experiences (e.g. supply and sales related jobs) would

continue the experiment, and the rest were screened out from the study. In addition, before the presence of the scenarios, the participants were required to acknowledge that they had been informed that they would be presented with a hypothetical scenario and would take their time reviewing the scenario. They were also informed that they would be asked questions about basic facts provided in the scenario and only those who consented to take this quiz and answered the questions correctly could continue the experiment.

Manipulations

Next, the participants were presented with the hypothetical situation (an example is shown in Figure 2.2). The participants were first asked to consider themselves a sales manager in a supplying firm and were told that the supplying firm has a long-term relationship with a buying firm that accounts for 20% of the supplier's revenue.

The participants were then presented with one scenario that consisted of two manipulation factors, namely the network governance mechanism, i.e., level of embeddedness of the buyer in the supplier's network (high vs. low), and the dyadic governance mechanism adopted by the buyer (muscular vs. benign vs. credible). Each participant was randomly assigned by one of six (2 by 3) scenarios. Table 2.1 shows all levels of the two manipulation factors.

After reading the hypothetical scenarios, participants were asked to take a quiz consisting of two multiple-choices questions to test their understanding of the reading material. The experiments would continue only if a participant answered both questions correctly. If a participant answered one or both questions incorrectly, he or she would be asked to read the material again and re-take the quiz until both questions were correctly answered. This ensured that the participants to read the material carefully to obtain the basic knowledge for the experiment. After the quiz,

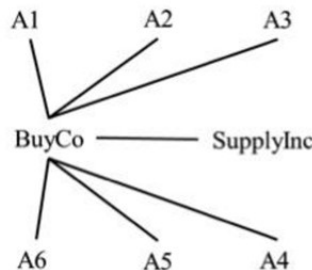
Please read the following descriptions carefully and answer the questions below.

You are a sales manager of a company named "SupplyInc". One of your major clients is "BuyCo", which has been purchasing "goods" from you on a regular basis for five years. Each year, BuyCo purchases about one million units of "goods" from you which contributes to approximately 20% of your revenue. You count on BuyCo's business while you know BuyCo is depending on your supply too.

Throughout the years, SupplyInc and BuyCo have formed an **adversarial** relationship. Because SupplyInc depends on BuyCo's business, BuyCo has power over SupplyInc and **does not hesitate to execute its power**. In general, BuyCo not only uses their suppliers, but it often 'uses up' their suppliers and discards them. When a problem arises, BuyCo attempts to **shift the financial burden of the problem to SupplyInc** to protect BuyCo's own interests.



BuyCo has close relationships with firms A1 - A6 and could share information with them. However, **NONE** of them are connected to SupplyInc and **NONE** are SupplyInc's major customers. The relationships are shown in the figure below.



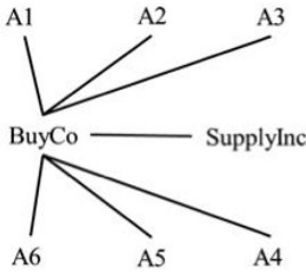
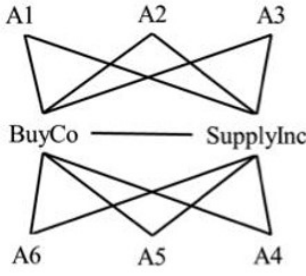
There are two levels of quality "goods" (standard and premium). The cost of premium quality is higher than the standard quality so that the profit you can make per shipment is less. On the other hand, the premium quality products are more valuable to a buyer. However, **at the point of delivery, the buyer will NOT know the quality**. The buyer will **ONLY** discover the quality **AFTER** the "goods" have been processed after the sale, and the quality is **disclosed ONLY** to that particular buyer, **NOT** to other companies in the market.

So far, BuyCo has been purchasing the **STANDARD** quality products from you. But for the next shipment, BuyCo has ordered the **PREMIUM** quality products. BuyCo will not discover the quality until the "goods" have been processed after the sale.



Figure 2.2: An Example of the Hypothetical Scenarios in Study 1

Table 2.1: Description of Different Levels of the Manipulation Factors in Study 1

Level of Embeddedness	
High	<p>BuyCo has close relationships with firms A1 - A6 and could share information with them. In addition, ALL of them are connected to SupplyInc and ALL are SupplyInc's major customers. The relationships are shown in the figure below.</p>  <pre> graph TD A1 --- BuyCo A2 --- BuyCo A3 --- BuyCo A4 --- BuyCo A5 --- BuyCo A6 --- BuyCo BuyCo --- SupplyInc A1 --- SupplyInc A2 --- SupplyInc A3 --- SupplyInc A4 --- SupplyInc A5 --- SupplyInc A6 --- SupplyInc </pre>
Low	<p>BuyCo has close relationships with firms A1 - A6 and could share information with them. However, NONE of them are connected to SupplyInc and NONE are SupplyInc's major customers. The relationships are shown in the figure below.</p>  <pre> graph TD A1 --- BuyCo A2 --- BuyCo A3 --- BuyCo A4 --- BuyCo A5 --- BuyCo A6 --- BuyCo BuyCo --- SupplyInc A1 --- A2 A2 --- A3 A3 --- A4 A4 --- A5 A5 --- A6 A6 --- A1 </pre>
Dyadic governance mechanism	
Muscular	<p>Throughout the years, SupplyInc and BuyCo have formed an adversarial relationship. Because SupplyInc depends on BuyCo's business, BuyCo has power over SupplyInc and does not hesitate to execute its power. In general, BuyCo not only uses their suppliers, but it often 'uses up' their suppliers and discards them. When a problem arises, BuyCo attempts to shift the financial burden of the problem to SupplyInc to protect BuyCo's own interests.</p>
Benign	<p>Throughout the years, SupplyInc and BuyCo have formed a cooperative relationship. Although SupplyInc depends on BuyCo's business and BuyCo has power over SupplyInc, BuyCo does not execute its power when interacting with SupplyInc but uses "trust" instead. In general, BuyCo trusts SupplyInc to work at BuyCo's best interest. When a problem arises, BuyCo simply trusts that SupplyInc has done its best, and always works with SupplyInc to overcome the problem.</p>
Credible	<p>Throughout the years, SupplyInc and BuyCo have formed a cooperative relationship with caution. Although SupplyInc depends on BuyCo's business and BuyCo has power over SupplyInc, BuyCo is hardheaded without being mean spirited. In general, BuyCo exercises feasible foresight, looks ahead, uncovers potential hazards, works out the mechanisms and factors these back into the contractual design. When a problem arises, BuyCo always has a proactive plan and/or the ability to sort out the root causes and deals with the problem based on the predetermined plan.</p>

the participants were asked to answer a series of questions regarding the manipulation factors for the manipulation check.

Measures of key variables

The third step consisted of answering psychometric questions about their predictions on the impact if they were to behave opportunistically by delivering products at a lower quality level than promised, and finally their intention to deliver lower quality products. For the psychometric questions, we limited the number of measurement items to avoid fatigue while assuring content validity through pretest and pilot test. A Q-sort test was also conducted to ensure the content validity in the design stage. Measures were also included for other validity checks (discussed below).

In particular, participants were asked to rate their level of agreement to a set of statements based on the scenario information (1 = strongly disagree, 7 = strongly agree). The measurement model's preliminary 12 items, which had been refined from the pretest and pilot tests, were assessed using confirmatory factor analysis (CFA). We found two items required removal because of poor psychometric properties. Each construct had at least two items, providing an acceptable measurement structure with acceptable reliability and reflecting the theoretical content (Hair et al., 1998). The details of the measurement items, as well as the reliability coefficients and the sources, are shown in (Table 2.2) and are discussed in the results section. We note the final dependent variable, supplier's opportunistic behavioral intention, is measured using both Likert-type scale questions (1 = strongly disagree, 7 = strongly agree) and a continuous item (probability in percentage). Due to the different scales of these items, we transformed all variables to the corresponding z-score value and used the z-score values for all the analysis.

Table 2.2: Measurement Model Results of Study 1

Construct	Items ^a	Standardized loading	t-value
Negative dyadic effect prediction (Cronbach's Alpha=0.825): developed from definition			
	(ZNDP2) IF I deliver the STANDARD quality "goods" instead of PREMIUM, It may negatively affect our future business with BuyCo.	0.880***	12.408
	(ZNDP3) IF I deliver the STANDARD quality "goods" instead of PREMIUM, It may negatively affect the relationship between my company and BuyCo.	0.799***	9.631
Negative network effect prediction (Cronbach's Alpha=0.948): developed from definition			
	(ZNNP1) IF I deliver the STANDARD quality "goods" instead of PREMIUM, It may negatively impact our reputation in the market.	0.957***	16.147
	(ZNNP2) IF I deliver the STANDARD quality "goods" instead of PREMIUM, It may negatively affect our relationship with other customers.	0.939***	17.838
	(ZNNP3) IF I deliver the STANDARD quality "goods" instead of PREMIUM, My other customers may see my company unfavorably.	0.883***	13.314
Negative affective prediction (Cronbach's Alpha=0.941): adapted from Watson, Clark, and Tellegen (1988)			
	(ZNAP1) IF I deliver the STANDARD quality "goods" instead of PREMIUM, I will feel Nervous	0.867***	12.904
	(ZNAP2) IF I deliver the STANDARD quality "goods" instead of PREMIUM, I will feel Afraid	0.920***	17.984
	(ZNAP3) IF I deliver the STANDARD quality "goods" instead of PREMIUM, I will feel Fearful	0.956***	18.814
	(ZNAP5) IF I deliver the STANDARD quality "goods" instead of PREMIUM, I will feel Anxious	0.828***	10.872
Opportunistic behavioral intention (Cronbach's Alpha=0.809): developed from definition			
	(ZO_OBI1) how likely are you to deliver the STANDARD quality of "goods" to BuyCo in the next shipment?	0.977***	15.577
	(ZO_OBI2) how likely are you to deliver the PREMIUM quality of "goods" to BuyCo in the next shipment? ^b	0.732***	9.442
	(ZO_OBI3) Probability of you to deliver the STANDARD quality goods (in percentage)	0.639***	8.632

* $p < .10$, ** $p < .05$, *** $p < .01$,

a. all items are normalized by using the corresponding z-score values,

b. reverse coded.

Control and validation variables

In the last step, participants were asked for ethicality, risk propensity, and demographic questions, which were collected as control variables. The ethicality was measured using a mini role play scenario suggested by (Reidenbach and Robin, 1990) because the opportunistic behavioral intention could be highly affected by one’s ethicality level. Risk propensity was measured using items developed by Meertens and Lion (2008) included because opportunistic behaviors can be considered as risk-taking behaviors. The following demographic variables were collected because of potential biases toward opportunistic behavioral intention: gender, age, experience, education, and race (Ribbink and Grimm, 2014; Tangpong et al., 2014, 2010). Other validity measures are also included in this section (Chen et al., 2015). These items include “I think the study is realistic,” “I think the instructions are clear,” and “I could imagine myself in the situation.”

Validity Checks

To ensure internal validity, which is a strength of behavioral experiments, we first randomly assigned each participant to one of the six scenarios. A multivariate test was conducted to ensure that no confounding effects existed with the treatment level to have a direct impact on the demographic variables in the model. The multivariate test revealed no significant differences between low-high manipulations of any demographic variables: level of embeddedness (p -values ranged from 0.296 to 0.961), and dyadic governance mechanisms (p -values ranged from 0.231 to 0.984). Therefore, no confounding effects were detected. In addition, manipulation checks were conducted to ensure the effectiveness of manipulation. One-way ANOVA was conducted to test whether the questions associated are different across the different levels of each of the

manipulation variable. The result shows that all questions are significantly different at 0.05 level which indicates the manipulation was effective.

Social desirability bias is another concern in this study because of the variable of interests in this study (i.e., opportunistic behavioral intentions). Several approaches were implemented to mitigate this bias. First, we used “standard” vs. “premium” quality levels to avoid undesirability bias created by using words such as “low quality” or “defective products”. In addition, for the dependent variable, supplier’s opportunistic behavioral intentions, we used the other-based questions for analysis suggested by Fisher (1993). The questions were framed in the following way:

“For the next two questions, please consider another person, who is similar to you, as the sales manager of SupplyInc... how likely is he/she will deliver the STANDARD quality ‘goods’ to BuyCo in the next shipment...What is the probability of him/her delivering the STANDARD quality goods vs. the PREMIUM quality goods?”

In addition, three social desirability bias items were also included in the demographic section including: “I am always careful about my manner of dress,” “My table manners at home are as good as when I eat out in a restaurant,” and “I have never intensely disliked anyone” (Crowne and Marlowe, 1960). A post-hoc analysis was conducted and the results show that the hypotheses tests results were consistent if these items were added in the models. Therefore, social desirability bias was sufficiently mitigated in this study.

2.3.3 Analysis and Results

We conducted the analysis following the structural equation models (SEM) for experimental studies suggested by Bagozzi and Yi (1989). The SEM approach is pre-

ferred over OLS regression because it takes into consideration the measure errors of the latent factors, such as the negative network-effect prediction and supplier’s opportunistic behavioral intention in this study. We followed the two-step method for analyzing SEM, where we first refined and assessed a measurement model for appropriate psychometric properties, and then tested a structural model for appropriate fit and hypothesis testing using the structural parameters (Anderson and Gerbing, 1988). In particular, since our hypothesized model includes dummy manifest variables representing different levels of the two experimental factors, namely the level of embeddedness and dyadic governance approaches, the Bagozzi and Yi (1989) approach was implemented using a mean-covariance structure and a series of equations were created to test hypotheses related to the two experimental factors. Therefore, a mean-covariance structure was used for both the measurement model and the structural model.

Measurement model

The CFA was conducted to assess the measurement model using EQS software (Byrne, 2006). Only the continuous, measured factors were included at this stage because the binary manipulation factors were to be entered subsequently (Bagozzi and Yi, 1989). The fit statistics showed adequate fit with $\chi^2(df) = 25.153(16)$ and $p = 0.067$, $CFI = 0.983$, $IFI = 0.983$, and $RMSEA = 0.054$ (with a confidence interval between 0.019 and 0.081). All loadings were significant and above 0.6 (Table 2.2). Furthermore, a CFA was done that allowed a latent common methods factor to explain item variance (Podsakoff et al., 2003). In addition, adequate construct reliability was achieved with Cronbach’s alphas of each factor above 0.8 (McDonald, 2013). Item-level descriptive statistics and correlations are shown in Table 2.3.

Table 2.3: Item Correlations and Descriptive Statistics

	ZNDP 2	ZNDP3	ZNNP1	ZNNP2	ZNNP3	ZNAP1	ZNAP2	ZNAP3	ZNAP5	ZO_OBI1	ZO_OBI2	ZO_OBI3
ZNDP2	0.852											
ZNDP3	0.629	0.94										
ZNNP1	0.582	0.529	0.907									
ZNNP2	0.521	0.548	0.833	0.948								
ZNNP3	0.514	0.499	0.759	0.775	0.903							
ZNAP1	0.439	0.453	0.316	0.306	0.368	0.919						
ZNAP2	0.335	0.349	0.242	0.259	0.277	0.711	0.949					
ZNAP3	0.383	0.337	0.26	0.247	0.338	0.751	0.846	0.925				
ZNAP5	0.419	0.386	0.294	0.307	0.34	0.724	0.653	0.678	0.841			
ZO_OBI1	-0.188	-0.143	-0.067	-0.077	-0.061	-0.344	-0.293	-0.321	-0.274	0.931		
ZO_OBI2	-0.206	-0.153	-0.103	-0.126	-0.085	-0.291	-0.216	-0.254	-0.261	0.656	0.899	
ZO_OBI3	-0.251	-0.244	-0.078	-0.089	-0.127	-0.373	-0.265	-0.337	-0.292	0.596	0.391	0.977
Mean	0.0516	0.0233	0.0653	0.0406	0.0366	0.0039	0.0511	0.0428	0.074	-0.0493	-0.0254	0.0007
Std. Dev.	0.9233	0.9696	0.9524	0.9736	0.9504	0.9588	0.9742	0.9619	0.917	0.9646	0.9481	0.9885

Hypothesis tests

To test the hypotheses of the effects of the treatment variables (H1-H5), we followed the approach for SEM testing in experimental designs where the estimation method uses univariate tests of treatment variables by using a mean-covariance structure (Bagozzi and Yi, 1989). The goal is to focus on the means, in addition to covariances, to analyze the hypothesized experimental effects on the supplier's opportunistic behavioral intention and the three perceived costs. In EQS, this structured-mean approach was accomplished through use of the V999 constant to estimate the factor mean (Byrne, 2006; Kull et al., 2014). Dummy variables were specified as exogenous latent variables with a single indicator and no residual.

Analysis was done with maximum likelihood estimation using the augmented moment matrix, which enables the use of the mean-covariance structure (Bagozzi and Yi, 1989), and a series of models were tested. To test the Hypotheses 1 and 2, we first constrained the paths of the exogenous factors equal to zero and then performed a Lagrange multiplier univariate chi-square test (LM test) to determine if releasing the zero-value path constraint improved model fit. In particular, the direct effects on supplier's opportunistic behavioral intention from embeddedness (H1) and dyadic

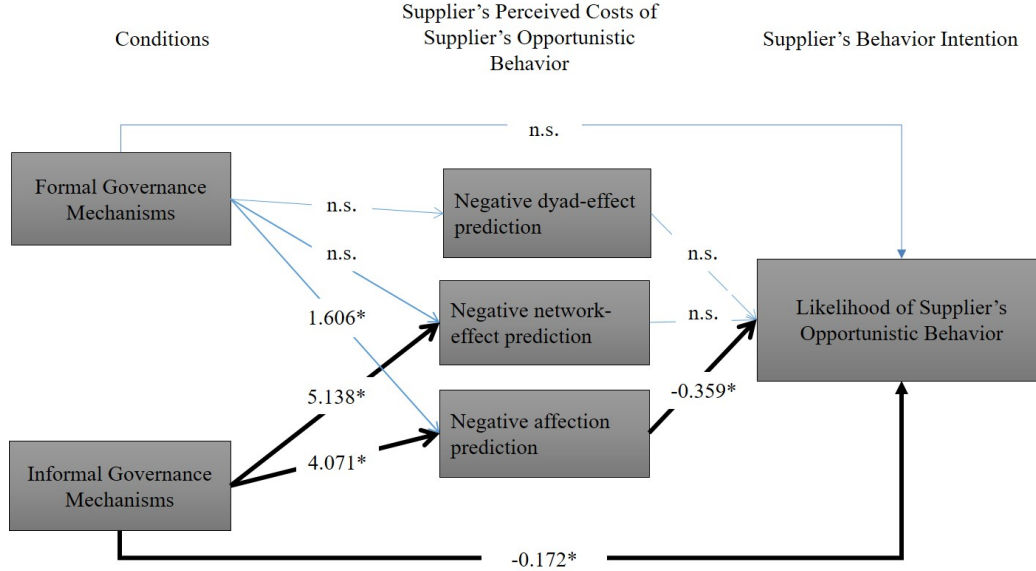


Figure 2.3: Analysis Results for Study 1

governance approaches (H2a and H2b) were tested. The overall model results are presented in Figure 2.3. The fit of the model is adequate with $\chi^2(df) = 60.13(51)$ and $p = .17$, $CFI = 0.97$, $IFI = 0.92$, and $RMSEA = 0.03$ (with a confidence interval of between 0.00 and 0.07). Hypothesis 1, positing that embeddedness decreases supplier's opportunistic behavioral intention, was supported ($\beta = -0.172$, $p < .05$). H2, positing that muscular and benign approach would cause a higher supplier's opportunistic behavioral intention than the credible approach, were not supported as the LM test did not detect a significant univariate chi-square improvement for neither muscular (with $\chi^2(df) = 1.408(1)$ and $p > 0.05$) nor benign (with $\chi^2(df) = 0.231(1)$ and $p > 0.05$) which are represented as "n.s." in Figure 2.3.

To test the effects of the treatment variables on the three perceived costs in H3 to H5, a similar approach was used in which the paths of the exogenous factors were constrained to zero and then a LM test was conducted to determine if releasing the zero-value path constraint improved model fit. H3, positing that the supplier's negative dyadic-effect prediction is lower in the benign relationship than in a credible

relationship, was not supported as the LM test did not detect a significant univariate chi-square improvement with $\chi^2(df) = 0.674(1)$ and $p = 0.412$, although the fit of the model is adequate with $\chi^2(df) = 19.5(12)$ and $p = .07$, $CFI = 0.951$, $IFI = 0.964$, and $RMSEA = 0.064$ (with a confidence interval of between .00 and .102).

H4a, positing that the supplier's negative network-effect prediction is lower in the benign relationship than in a credible relationship, was not supported as the LM test did not detect a significant univariate chi-square improvement with $\chi^2(df) = 0.492(1)$ and $p = 0.483$, although the fit of the model is adequate with $\chi^2(df) = 48.812(41)$ and $p = .18$, $CFI = 0.970$, $IFI = 0.971$, and $RMSEA = 0.037$ (with a confidence interval of between .00 and .61). On the other hand, H4b, positing that the supplier's negative network-effect prediction is higher if the buyer's level of embeddedness is high, was supported ($\beta = 5.138$, $p < .05$).

Finally, H5a, positing that the supplier's negative affection prediction is lower in the muscular relationship than in a credible relationship, was not supported. But, surprisingly, the path is significant to the opposite direction ($\beta = 1.606$, $p < .05$) which indicates that the adversarial nature of the muscular approach actually increases the supplier's negative feelings (e.g., anxiety for being punished). H5b, positing that the embeddedness increases the negative affection prediction, was supported ($\beta = 4.071$, $p < .05$). The fit of the model is adequate with $\chi^2(df) = 28.069(16)$ and $p = .03$, $CFI = 0.962$, $IFI = 0.966$, and $RMSEA = 0.07$ (with a confidence interval of between .039 and .098).

The remaining hypotheses investigated the relationships between the three perceived costs and the opportunistic behavioral intention (H6a to H6c). These paths were tested following standard SEM parameter significance tests. H6a, positing that the negative dyadic-effect prediction decreases the supplier's opportunistic behavioral intention, was not supported ($\beta = -0.200$, $p > .05$), as was H6b, positing that the

negative network-effect prediction decreases the supplier's opportunistic behavioral intention ($\beta = 0.174, p > .05$). On the other hand, H6c, positing that the negative affection prediction decreases the supplier's opportunistic behavioral intention, was supported ($\beta = -0.359, p < 0.05$). The above results suggest that, while managers make decisions on whether to engage in an opportunistic behavior, they tend to focus more on their own affections than the other party's (the buyer's) possible reactions.

Additional to the approach suggested by Bagozzi and Yi (1989), we also conducted path analysis in SEM to test the mediation effects of supplier's perceived costs. The associations of informal and formal mechanisms with supplier's opportunistic behavioral intention and the indirect paths via supplier's perceived costs were then examined using multiple mediation models performed with EQS 6.2 (Byrne, 2006). Separate path models were tested for each exogenous factor respectively which is a common practice for complicated models with small sample size (Gordon et al., 2016; Prahinski and Benton, 2004). Each path model tested multiple indirect pathways linking the respective exogenous factor (embeddedness or relational norms) with supplier's opportunistic behavioral intention through the supplier's perceived costs (negative direct-effect prediction, negative network-effect prediction, and negative affection predictions). The significance of each indirect effect (e.g. embeddedness→Perceived costs→supplier's opportunistic behavioral intention) was determined using bootstrapping with 5,000 resamples (Hayes, 2013; Gordon et al., 2016). Each model controlled for gender, age, experience, education, race, ethicality, and risk propensity.

The results from the path analysis is summarized in Table 2.4. As shown in Table 2.4, embeddedness was significantly and positively associated with negative affection prediction ($\beta = 1.429, p < .05$) and negative affection prediction is negatively associated with supplier's opportunistic behavioral intention ($\beta = -0.435, p < .05$). This provides support for H5b and H6c. In addition, there are a significant

Table 2.4: Summary of Path Analysis in Study 1

Path model (Embeddedness)	Embeddedness Standardized coefficients
Paths (Embeddedness--> Perceived costs)	
Embeddedness--> Negative direct-effect prediction	0.431
Embeddedness--> Negative network-effect prediction	0.374
Embeddedness--> Negative affection prediction	1.429 *
Paths (Perceived costs--> Opportunistic behavioral intention)	
Negative direct-effect prediction-->Opportunistic behavioral intention	0.019
Negative network-effect prediction-->Opportunistic behavioral intention	0.118
Negative affection prediction-->Opportunistic behavioral intention	-0.435 *
Indirect path (Embeddedness--> Perceived costs-->Opportunistic behavioral intention)	-0.57 *
Direct path (Embeddedness-->Opportunistic behavioral intention)	-0.202 *

Path model (Relational Norm)	RN_Muscular	RN_Benign
Paths (RN--> Perceived costs)	Standardized coefficients	
RN--> Negative direct-effect prediction	0.586	-0.193 *
RN--> Negative network-effect prediction	0.507	1.163 *
RN--> Negative affection prediction	0.932	-0.591
Paths (Perceived costs--> Opportunistic behavioral intention)		
Negative direct-effect prediction-->Opportunistic behavioral intention	-0.324	
Negative network-effect prediction-->Opportunistic behavioral intention	0.332	
Negative affection prediction-->Opportunistic behavioral intention	-0.37 *	
Indirect path (RN--> Perceived costs-->Opportunistic behavioral intention)	-0.367	0.667
Direct path (RN--> Opportunistic behavioral intention)	-0.172 *	-0.121

* indicates significant at 0.05 level

negative direct effect between embeddedness and opportunistic behavioral intention ($\beta = -0.570$, $p < .05$) and a significant negative indirect effect linking embeddedness with opportunistic behavioral intention through the three perceived costs. The results indicates that embeddedness decreases the level of the supplier's opportunistic behavioral intention and the relationship is partially mediated by the supplier's perceived costs. Therefore, H1 is also supported.

The results from the path model of relational norm show that the benign relationship, in comparison with the credible relationship, was negatively associated with negative direct-effect prediction ($\beta = -0.193$, $p < .05$) and positively associated with negative network-effect prediction ($\beta = 1.163$, $p < .05$). This provides support for H3 but is opposite to H4a. The results also show that negative affection prediction is negatively associated with the supplier's opportunistic behavioral intention ($\beta = -0.370$, $p < .05$) which also provides support for H6c. In addition, there is a

significant negative direct effect between muscular relationship and opportunistic behavioral intention ($\beta = -0.172, p < .05$) and no significant indirect effect through the three perceived costs. The results indicates that while muscular relationship decreases the level of supplier’s opportunistic behavioral intention, the effect is not mediated by the supplier’s perceived costs. On the other hand, there is no significant direct or indirect effect between benign relationship and opportunistic behavioral intention. Therefore, H2a is supported but H2b is not.

While the results using the path models are largely consistent with those using the SEM for experimental design approach, and it is preferred for testing mediation models (Zhao et al., 2010), the path models do not address the fact that the two exogenous factors are dummy variables, not continuous. Therefore, we still rely on the results using Bagozzi and Yi’s (1989) approach for this study.

2.3.4 Discussion

The results of Study 1 show that network governance mechanism, i.e, the embeddedness, has a direct effect in decreasing the supplier’s opportunistic behavioral intention and is partially mediated by the supplier’s negative affection prediction. However, the hypotheses regarding that the supplier’s opportunistic behavioral intention differs across different dyadic governance mechanism were not supported. An unexpected finding is that the muscular approach causes a higher level of supplier’s negative affection prediction which, in turn, decreases the supplier’s opportunistic behavioral intention. While literature has suggested that adversarial/competitive supply chain relationship decreases the relationship commitment and increases supplier’s opportunistic behavior in a long term (Kim and Choi, 2015), in a short term, as in this one-shot experiment, such approach could create a credible threat that immediately decreases the supplier’s opportunistic behavioral intention.

Another finding from Study 1 is that, among the three perceived costs, only the negative affection prediction is negatively associated with the supplier's opportunistic behavioral intention. This find indicates that, while making decisions on whether to engage in an opportunistic behavior in a transaction, managers tend to focus more on their own affections than the buyer's possible reactions. Since both the negative dyadic-effect prediction and the negative network-effect prediction reflect the supplier's prediction of the buyer's reaction, it would be interesting to examine the buyer's actual reactions. Therefore, we also developed Study 2, which takes the buyer's perspective in order to investigate whether and how the buyer reacts to potential supplier opportunism.

2.4 Study 2

While in Study 1, we tested the effects of embeddedness and the dyadic governance mechanisms on supplier's opportunistic behavioral intention mediated through the supplier's perceived costs for being opportunistic: the prediction of the buyer's reactions such as spreading the words and terminating the relationship, and the prediction of internal affection such as feeling nervous and anxious. As the saying goes, "It takes two to tango." Therefore, we developed Study 2 that takes the buyer's perspective to examine the buyer's reaction to a potential supplier opportunism.

In particular, we investigated the effects of dyadic governance mechanism (same as in Study 1) and the supplier's performance outcome on the buyer's negative word-of-mouth (WOM) intention and relationship commitment with the supplier. Note that the buyer's negative WOM intention and relationship commitment were reflected as the negative network-effect prediction and negative dyadic-effect prediction, respectively, in Study 1, and that a low level of the supplier's performance outcome reflects the supplier's opportunistic behavior in Study 1. Therefore, the two studies are highly

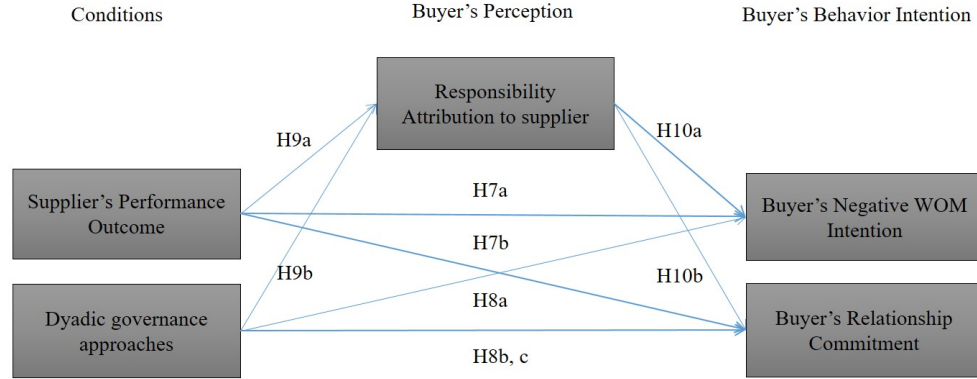


Figure 2.4: Hypothesized Model for Study 2

related in that, in Study 1, we examined the supplier's behavioral intention affected by its prediction of the buyer's reaction; while in Study 2, we examined the buyer's reaction given the supplier's behavioral outcome. In addition, we hypothesize that the effects of the performance outcome are moderated by dyadic governance mechanism. The hypothesized model for Study 2 is shown in Figure 2.4.

2.4.1 Development of Hypotheses

First, we hypothesize that the supplier's performance outcome has a main effect on the buyer's negative WOM intention. In particular, a poor supplier's performance outcome would increase the buyer's negative WOM intention, which is defined as a person's perceived likelihood or subjective probability that he or she will engage in a negative word-of-mouth communication. A negative word-of-mouth communication refers to an exchange of thoughts, ideas, or comments that emphasize the negative side of a product or a service, between two or more consumers, none of whom is a marketing source. For example, they tell others, external to the transaction, of their displeasure or dissatisfaction with a service and a service provider. Literature has shown that bad events generally have larger impacts than good events. Baumeister et al. (2001) has reviewed extensive literature on the positive-negative asymmetry

effect and found that the bad events are more powerful than good ones in everyday events, interpersonal interactions, and etc. In particular, people react more strongly to bad than good events (Brickman et al., 1978; David et al., 1997; Nezlek and Gable, 2001; Sheldon et al., 1996). In addition, because bad information receives more thorough information processing than good information, “the most widely read classes of writers—journalists and novelists—both devote the bulk of their writing to elaborating bad rather than good events” (Baumeister et al., 2001, p. 343). Therefore, if the supplier’s performance outcome is lower than the buyer’s expectation, which implies a potential supplier opportunism, the buyer would be more likely to share this experience when an opportunity presents itself.

H7: *The buyer’s negative WOM intention is higher if the supplier’s performance outcome is low than if it is high.*

In addition, the dyadic governance mechanism adopted by the buyer, defined the same as in Study 1, could moderate the effect of the supplier’s performance on the buyer’s negative WOM intention. If the buyer adopts a benign approach, in which the buyer naively trusts the supplier and is passive in response to the supplier’s behavior (Williamson, 2008), the buyer is less likely to react by sharing its experience with others. Therefore, we have

H8: *The effect of the supplier’s performance outcome on the buyer’s negative WOM intention is smaller if the dyadic governance mechanism adopted by the buyer is benign than if it is credible.*

Not only does the buyer react to the supplier’s behavior through WOM, but the buyer could also adjust its level of commitment to the supplier. As the positive-negative asymmetry effect was found in literature, negative events and experience produce more negative emotion, have bigger effects on adjustment measures, and have longer

lasting effects (Baumeister et al., 2001). For example, evidence has shown that bad information about a person or new acquaintance carries more weight and has a larger impact on impressions than good information (Peeters and Czapinski, 1990). One explanation for this phenomenon is that when people categorize other individuals, to be categorized as good, one has to be good consistently, while, to be categorized as bad, a few bad acts are sufficient (Skowronski and Carlston, 1989). In this case, one or few negative experiences could jeopardize a good relationship. In addition, the SCM literature suggests that the supplier's performance and behavioral uncertainty creates a performance evaluation problem that decreases the buyer's trust and commitment to the supplier (Kwon and Suh, 2004). Therefore, a negative experience with the supplier will have a larger and negative impact on the buyer's commitment to the supplier.

H9: *The buyer's relationship commitment to the supplier is lower if the supplier's performance outcome is low than if it is high.*

In addition, the dyadic governance approach adopted by the buyer should also moderate the effect of the supplier's performance outcome on the buyer's commitment to the supplier. In particular, if the buyer adopts a muscular dyadic governance mechanism, the buyer is considered as acting in response to the supplier's behavior and behavioral outcome. In such relationships, the buyer has little tolerance if the supplier does not perform and is likely to transfer the financial burden to the supplier and to punish the supplier by terminating the relationship. Therefore, the effect of the supplier's performance outcome on the buyer's relationship commitment is larger in a muscular relationship than in a benign or credible relationship.

H10a: *The effect of the supplier's performance outcome on the buyer's relationship commitment is larger if the dyadic governance mechanism adopted by the buyer*

is muscular than if it is benign.

H10b: *The effect of the supplier's performance outcome on the buyer's relationship commitment is smaller if the dyadic governance mechanism adopted by the buyer is muscular than if it is muscular credible.*

2.4.2 Methodology

The hypotheses in Study 2 were tested using scenario-based role play experiment as in Study 1. The two studies were conducted simultaneously and the participants were recruited in the same way. As a potential participant signs up for the study, she will be assigned to only one study based on her experience provided in the pre-screening question. For example, after a practitioner agreed to participate the study and had read the consent information, she will be asked about current or previous working experience. If she reported to have experience on the supplying side, such as a sales or account manager, she would be assigned to Study 1. If she reported to have experience on the buying side, such as a procurement or supplier manager, she would be assigned to Study 2. If she reported experience in neither supplying nor buying, such as in HR or accounting, she would receive a thank you note and would be dropped from the experiment. In this case, we assured that each participant could only participate in one of the two studies to avoid the carrying-over effect, and the study assigned matched his or her own experience.

Participants and quality control for careless responses

The participants were from the same pool as in Study 1. After the pre-screening question and several validity checks to screen out the careless responses, 169 participants completed Study 1 (150 practitioners and 19 MBA students) using an online

survey. We deleted 13 cases, which were identified as multivariate outliers using Mahalanobis distance in SPSS (Meade and Craig, 2012). The sample of data analyzed contained 156 cases.

As in Study 1, we randomly assigned participants to different one-shot, hypothetical scenarios following recommendations by Rungtusanatham et al. (2011). We have also conducted a pretest with 5 practitioners to ensure that responding managers would have no difficulty understanding the meaning of the related constructs and that the issues are common and relevant. Three rounds of pilot tests were then conducted with both undergraduate and graduate students (164, 73, and 67 participants, respectively) from a large research university to refine the experimental design, improve the measurement model, and ensure manipulation validity (Rungtusanatham et al., 2011). We used the same approaches to screen out careless responses as described in Study 1.

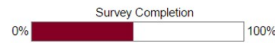
Procedure of experiment

The procedure of the experiment is similar to the procedure in Study 1. During the experiment, managers were first presented with the same informed consent in which the general nature and intent of the experiment were given (i.e., to improve understanding of buyer-supplier relationships). Next, participants were asked about their current and previous working experience as a qualification to participate in the study. The participants were also required to acknowledge that they had read a statement informing them that they will next be presented with a hypothetical scenario and to take their time reviewing the scenario. They were also required to acknowledge that they will be asked questions about basic facts provided in the scenario and only if they answer the questions correctly could they continue the experiment.

Please read the following descriptions carefully and answer the questions below.

You are a purchasing manager of a company named "BuyCo ". One of your major supplier is "SupplyInc" who has been supplying "goods" to you on a regular basis for five years. Each year, BuyCo purchases about one million units of "goods" from this supplier which contributes to approximately 20% of your bill of Materials (BOM). You depend on SupplyInc's supply and you know SupplyInc counts on your business too.

Throughout the years, SupplyInc and BuyCo have formed a **cooperative** relationship. Although SupplyInc depends on BuyCo's business and BuyCo has power over SupplyInc, BuyCo **does not execute its power** when interacting with SupplyInc **but uses "trust" instead**. In general, BuyCo trusts SupplyInc to work for BuyCo's best interest. When a problem arises, BuyCo **simply trusts** that SupplyInc has done its best, and always works with SupplyInc to overcome the problem.



There are **two levels of quality** "goods" (**standard** and **premium**). The **premium quality products are more valuable to you** and you can make a higher profit margin using premium quality "goods". On the other hand, **the cost of premium quality is higher for your supplier** than the standard quality so that the profit your supplier can make per shipment is less.

Historically, BuyCo has purchased **ONLY the standard quality** products from SupplyInc. But for the last shipment, BuyCo ordered the **premium** quality products. After the transaction was done and the "goods" processed, BuyCo's engineers discovered that the quality of the last shipment is **similar to** the standard quality products that they usually received. Since the quality of this shipment is **NOT as high as expected**, BuyCo would make **a lower profit than expected**. So far, only BuyCo knows the quality level of the last shipment, **i.e. NO other companies know**.

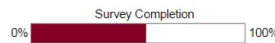


Figure 2.5: An Example of the Hypothetical Scenarios in Study 2

Manipulations

Next, the participants were presented with the hypothetical situation (an example is shown in Figure 2.5). The participants were first asked to consider themselves a purchasing manager in a buying firm that has a long-term relationship with a supplier accounting for 20% of the buyer's bill of materials (BOM).

The participants were then presented with one scenario consisting of two manipulation factors, namely the dyadic governance mechanisms adopted by the buyer (muscular vs. benign vs. credible) and the supplier's performance outcome in the last shipment (high vs. low quality). Each participant was randomly assigned by one of six (2 by 3) scenarios. Table 2.5 shows all levels of the two manipulation factors.

After reading the hypothetical scenarios, participants were asked to take a quiz consisting of two multiple choices questions to test their understanding of the reading

Table 2.5: Description of Different Levels of the Manipulation Factors in Study 2

Performance outcome	
High	Historically, BuyCo has purchased ONLY the standard quality products from SupplyInc. But for the last shipment, BuyCo ordered the premium quality products. Only after the transaction was done and BuyCo's production team processed the goods did the engineers find out that the quality of this shipment is significantly better than the standard quality products that they usually received. Since the quality of this shipment is as high as expected, BuyCo would make a high profit as expected. So far, only BuyCo knows the quality level of the last shipment, i.e. NO other companies know.
Low	Historically, BuyCo has purchased ONLY the standard quality products from SupplyInc. But for the last shipment, BuyCo ordered the premium quality products. After the transaction was done and the "goods" processed, BuyCo's engineers discovered that the quality of the last shipment is similar to the standard quality products that they usually received. Since the quality of this shipment is NOT as high as expected, BuyCo would make a lower profit than expected. So far, only BuyCo knows the quality level of the last shipment, i.e. NO other companies know.
Dyadic governance mechanism	
Muscular	Throughout the years, SupplyInc and BuyCo have formed an adversarial relationship. Because SupplyInc depends on BuyCo's business, BuyCo has power over SupplyInc and does not hesitate to execute its power. In general, BuyCo not only uses their suppliers, but it often 'uses up' their suppliers and discards them. When a problem arises, BuyCo attempts to shift the financial burden of the problem to SupplyInc to protect BuyCo's own interests.
Benign	Throughout the years, SupplyInc and BuyCo have formed a cooperative relationship. Although SupplyInc depends on BuyCo's business and BuyCo has power over SupplyInc, BuyCo does not execute its power when interacting with SupplyInc but uses "trust" instead. In general, BuyCo trusts SupplyInc to work at BuyCo's best interest. When a problem arises, BuyCo simply trusts that SupplyInc has done its best, and always works with SupplyInc to overcome the problem.
Credible	Throughout the years, SupplyInc and BuyCo have formed a cooperative relationship with caution. Although SupplyInc depends on BuyCo's business and BuyCo has power over SupplyInc, BuyCo is hardheaded without being mean spirited. In general, BuyCo exercises feasible foresight, looks ahead, uncovers potential hazards, works out the mechanisms and factors these back into the contractual design. When a problem arises, BuyCo always has a proactive plan and/or the ability to sort out the root causes and deals with the problem based on the predetermined plan.

material in the same manner as in Study 1, and the experiments would continue only if a participant answered both questions correctly. After the quiz, the participants were asked to answer a series of question regarding the manipulation factors, which are used as a manipulation check.

Measures of key variables

The third step for participants consisted of answering psychometric questions about their attribution of the quality of the product received in the last shipment to the supplier, their likelihood to engage in negative WOM, and their perceived relationship commitment after this shipment. To control for potential confounding effects from factors such as the potential impact of the negative WOM at both organizational and personal levels, the incidence for the WOM opportunity was provided to the participants. In particular, the participants read a short description that they were attending a conference and had met with another purchasing manager who could potentially be the supplier's customer and the participants were given an opportunity to share their opinions at a causal event. This situation reflects the embeddedness factor in Study 1 in that the buyer has a certain level of embeddedness to the supplier's network and is able to share information. The description is shown as below:

“Now consider yourself attending a conference where you ran into someone you had known from a previous conference. The two of you decide to have coffee together. As you two are chatting, you find out that the company which your friend works at is selecting a supplier for a big project and one of the final candidates is SupplyInc. Your friend is in charge of the supplier selection. Based on your understanding, the result of the selection will NOT affect BuyCo's business at all. Also, it's common in your business environment to comment on a supplier. And your comments, if you decide

Table 2.6: Measurement Model Results of Study 2

Construct	Items ^a	Standardized loading	t-value
Attribution (Cronbach's Alpha=0.710): adapted from Hartmann and Moeller (2014)			
	(ATTR1) SupplyInc's is responsible for the quality in the last shipment.	0.891***	8.889
	(ATTR2) SupplyInc should be held accountable for the quality in the last shipment.	0.720***	7.763
	(ATTR3) Whether the quality of last shipment meet BuyCo's expectation should be attributed to SupplyInc.	0.450***	5.232
Relationship commitment (Cronbach's Alpha=0.918): adapted from Kwon and Suh (2004)			
	(RC1) I expect this relationship between BuyCo and SupplyInc to continue for a long time.	0.942***	15.185
	(RC2) BuyCo is committed to SupplyInc.	0.797***	11.752
	(RC3) I expect the relationship between BuyCo and SupplyInc to strengthen over time.	0.928***	14.809
Negative WOM intention (Cronbach's Alpha=0.948): adapted from (Swanson & Kelley, 2001)			
	(O_NWOMI1) How likely would you.....mention your NEGATIVE experience with SupplyInc?	0.946***	15.596
	(O_NWOMI2) ...mention any dissatisfaction with SupplyInc to your friend?	0.922***	14.929
	(O_NWOMI2) ...express your dissatisfaction with SupplyInc to your friend?	0.911***	14.621

* $p < .10$, ** $p < .05$, *** $p < .01$.

a. all items are normalized by using the corresponding z-score values.

to share, will NOT affect BuyCo's business NOR your reputation. ”

Participants were asked to rate their level of agreement to a set of statements based on the scenario information (1 = strongly disagree, 7 = strongly agree). For the psychometric questions, we limited the number of measurement items to avoid fatigue. The measurement model's preliminary 9 items, which had been refined from the pretest, pilot tests and a Q sort test, were assessed using confirmatory factor analysis (CFA). We found one items required removal because of poor psychometric properties. Each construct had three items, providing an acceptable measurement structure with acceptable reliability and reflecting the theoretical content (Hair et al., 1998; Kline, 2015). Measures were also included for other validity checks (discussed below). The details of the key measurement items, as well as their reliability levels and sources, are shown in Table 2.6 and are discussed in the results section.

Control and validation variables

In the last step, participants were asked for ethicality, risk propensity, and demographic questions, which were collected as control variables as in Study 1. In addition, they were also asked about their non-directional WOM intention for control purposes. These items are: “How likely would you mention your experiences regarding SupplyInc’s most recent shipment with your friend?” “How likely would you mention your relationship with SupplyInc?” and “How likely would you NOT mention your relationship with SupplyInc?” (reversely coded). Responsibility attribution could also influence people’s emotional and behavioral reactions (Weiner, 1995) and a responsibility attribution of a negative incidence will generate negative behavioral reactions (Hartmann and Moeller, 2014). Therefore, we also include measures for the supplier’s attribution. These items include: “SupplyInc is responsible for the quality in the last shipment”, “SupplyInc should be held accountable for the quality in the last shipment”, and “Whether the quality of last shipment meet BuyCo’s expectation should be attributed to SupplyInc.” Lastly, as in Study 1, other validity measures are also included in this section (Chen et al., 2015). These items include: “I think the study is realistic,” “I think the instructions are clear,” and “I could imagine myself in the situation.”

Validity Checks

The validity checks followed the same approach as in study 1. To ensure internal validity, we first randomly assigned each participant to one of the six scenarios. The multivariate test revealed no significant differences between low-high manipulations of any demographic variables: level of embeddedness (p -values ranged from 0.296 to 0.961), and the dyadic governance mechanism (p -values ranged from 0.183 to 0.971).

Therefore, no confounding effects were detected. In addition, manipulation checks were conducted to ensure the effectiveness of manipulation. One-way ANOVA was conducted to test whether the questions associated are different across the different levels of each of the manipulation variables. The result shows that all questions are significantly different at 0.01 level which indicates the manipulation was effective.

Social desirability bias is also a concern in Study 2 because the WOM behavior can be considered gossip, which is generally not socially desired. Therefore, we also used the other-based items for analysis suggested by Fisher (1993). The questions were framed in the following way:

“Now consider another purchasing manager who is similar to you. How likely would he/she... (Be sure to give what you think others would do)?”

In addition, three social desirability bias items were also included in the demographic section including: “I am always careful about my manner of dress,” “My table manners at home are as good as when I eat out in a restaurant,” and “I have never intensely disliked anyone” (Crowne and Marlowe, 1960). A post-hoc analysis was conducted and the results from the hypotheses tests were consistent if these items were added in the models. Therefore, social desirability bias was sufficiently mitigated in this study.

2.4.3 Analysis and Results

We conducted the analysis following the SEM for experimental studies suggested by Bagozzi and Yi (1989). In particular, we conducted a three-group SEM analysis approach which allows us to test the interaction effect. Again, a mean-covariance structure was used for both the measurement model and the structural model.

Table 2.7: Item Correlations and Descriptive Statistics in Study 2

	RC1	RC2	RC3	ATTR1	ATTR2	ATTR3	O_NWOMI1	O_NWOMI2	O_NWOMI3
RC1	0.952								
RC2	0.658	0.86							
RC3	0.849	0.659	1						
ATTR1	0.077	0.121	0.018	0.743					
ATTR2	0.074	0.105	0.045	0.445	0.683				
ATTR3	-0.006	0.068	-0.018	0.328	0.241	0.804			
O_NWOMI1	-0.066	-0.062	-0.058	0.045	0.109	-0.046	0.978		
O_NWOMI2	-0.089	-0.102	-0.088	-0.022	0.059	-0.075	0.9	1.006	
O_NWOMI3	-0.074	-0.041	-0.054	-0.053	0.027	-0.088	0.875	0.892	1.006
Mean	0.077	0.1016	0.0581	0.0655	0.0786	0.0643	0.038	0.0104	0.0339
Std. Dev.	0.9758	0.9276	0.9999	0.862	0.8266	0.8965	0.9888	1.0029	1.0031

Measurement model

The CFA was conducted using EQS software (Byrne, 2006). Only the continuous, measured factors were included at this stage because the binary manipulation factors were to be entered subsequently (Bagozzi and Yi, 1989). The fit statistics showed adequate fit with $\chi^2(df) = 30.437(21)$ and $p = 0.083$, $CFI = 0.983$, $IFI = 0.983$, and $RMSEA = 0.048$ (with a confidence interval between 0.000 and .078). All loadings were significant and above 0.4 (see Table 2.6). Furthermore, a CFA was done that allowed a latent common methods factor to explain item variance (Podsakoff et al., 2003). In addition, adequate construct reliability was achieved with Cronbach's alphas of each factor above 0.7 (McDonald, 2013). Item-level descriptive statistics and correlations are shown in Table 2.7.

Hypothesis tests.

To test the hypotheses of the effects of the supplier's performance outcome (H7 and H9), and the moderation effect of dyadic governance mechanism on the supplier performance outcome (H8, H10a and H10b), we followed the approach for SEM testing in experimental designs suggested by (Bagozzi and Yi, 1989). In particular, we use three groups to represent the three dyadic governance mechanisms, and a dummy

variable for the supplier's performance outcome. Due to the relatively small sample size, we conducted the analysis for each dependent variable respectively to increase power. The analysis included four models for each dependent variable (summarized in Table 2.8). In particular, Model 1 consists of the dependent variable and control variables. All the coefficients for control variables are constrained to be equal across the three groups unless the LM test suggested to release the constraints. By doing this, the number of parameters are considerably reduced so that the threat of lack of power is reduced. Model 2 consists of the dependent variable, control variables, and the independent variable (i.e., a dummy variable for supplier's performance outcome). Except for the control variables, most of which were constrained to be equal across the three groups, all other parameters were allowed to estimate freely. In Model 3, the coefficients of the independent dummy variables are constrained to be equal across all three groups to test for interaction effect by comparing this restricted model to the previous less restricted model. In this test, a high Chi-square value from the LM test indicates that the null hypothesis (i.e. there is no interaction effect) is rejected. In Model 4, the coefficients of the independent dummy variable are constrained to be 0 across all three groups to test for the main effect by comparing this model to Model 3. Again, the Chi-square statistics in the LM test indicate whether this constraint should be released.

As shown in Table 2.8, there is no difference in the effect of the performance outcome on the buyer's negative WOM intention across the three groups. Therefore, H8 is not supported. On the other hand, the effects of performance outcome on the buyer's negative WOM differs across the three groups because the model fit is significantly worse in Model 3 than in Model 2, and LM test in Model 3 identified that the constraints that restricted the coefficients to be equal across groups should be released. Therefore, H10a and H10b are supported. Further, H7 and H9 were

Table 2.8: Summary of Analysis for Study 2

Model Dependent Variables Group	1 (Control variables only)				2 (No constraints)			
	Negative WOM Intention		Relationship Commitment		Negative WOM Intention		Relationship Commitment	
	Muscular	Benign	Credible	Benign	Muscular	Benign	Muscular	Benign
Control variables								
WOM Intention ^a	0.549 ^{ef}	0.534*	0.471*	0.158*	0.501*	0.455*	0.414*	0.453*
Attribution	0.09	-0.369*	-0.367*	0.079	0.099	-0.385*	-0.348*	0.026
Ethicality	-0.19	-0.12	-0.135	0.500*	-0.141	-0.087	-0.098	0.207*
Risk	0.21*	0.142*	0.162*	0.014	0.220*	0.147*	0.169*	0.048
Experience	-0.08	-0.047	-0.052	0.167*	-0.08	-0.047	-0.052	0.213*
Age	-0.08	-0.049	-0.056	0.055	-0.028	-0.017	-0.02	0.235*
Independent Variable								
Performance					-0.214	-0.245	-0.102	0.482*
Model Fit Indices ^b								
Chi_square ^c df p-value	140.54	121	0.1082	143.73	173.72	138	0.163	139
CFI		0.976			0.968			0.952
IFI		0.979			0.972			0.959
RMSEA (90% CI) ^d		0.056 (0.00, 0.092)		0.061 (0.000, 0.095)	0.062 (0.000, 0.094)		0.067 (0.020, 0.098)	
Model	3 (Interaction)				4 (Main effects)			
Dependent Variables	Negative WOM Intention		Relationship Commitment		Negative WOM Intention		Relationship Commitment	
Group	Muscular	Benign	Credible	Benign	Muscular	Benign	Muscular	Benign
Control variables								
WOM Intention ^a	0.540*	0.477*	0.400*	0.187*	0.636*	0.583*	0.504*	0.08
Attribution	-0.217	-0.115	-0.128	0.079	-0.23	-0.124	-0.141	0.103
Ethicality	-0.169	-0.105	-0.113	0.183*	-0.228*	-0.145*	-0.159*	0.318*
Risk	0.237*	0.159*	0.174*	0.029	0.224*	0.154*	0.173*	0.026
Experience	-0.156	-0.097	-0.103	0.181*	-0.144	-0.091	-0.171*	0.031
Age	-0.032	-0.019	-0.021	0.059	-0.09	-0.055	-0.062	0.183*
Independent Variable								
Performance	-0.260*	-0.167*	-0.181*	0.300*	0	0	0	0.161*
Model Fit Indices ^b								
Chi_square ^c df p-value	180.9	146	0.0264	177.66	187.55	147.00	201.07	142.00
CFI		0.957			0.949			0.906
IFI		0.962			0.955			0.92
RMSEA (90% CI) ^d		0.068 (0.025, 0.098)		0.071 (0.030, 0.101)	0.074 (0.035, 0.102)		0.090 (0.059, 0.117)	
LM test for Constraints								
Chi_square	beta_M=beta_B	beta_M=beta_C	beta_M=beta_B	beta_M=beta_C	beta_M=beta_B	beta_M=beta_C	beta_M=beta_B	beta_M=beta_C
p-value	0.007 (1)	0.496 (1)	5.201 (1)	7.483 (1)	0.001 (1)	0.075 (1)	4.854 (1)	8.904 (1)
	0.932	0.481	0.023	0.006	0.979	0.785	0.028	0.003
								0

a. Control variable are constrained to be equal across all three group unless identified from the LM test.

b. Based on the Robust method

c. The reported Chi_square is Satorra-Bentler Scaled Chi_square.

d. The reported RMSEA is based on both Covariance matrix and Means.

e. * indicates significant at 0.05 level.

f. Standardized coefficients.

tested by comparing the fitness indices of Model 4 and Model 3 as well as the LM test in Model 4. As shown in Table 2.8, both models are significantly worse in Model 4 than in Model 3, and the LM test in Model 4 identified that the constraints that restricted the coefficients to be equal to zero should be released. Therefore, both H7 and H9 were supported.

2.4.4 Discussion

The results of Study 2 show that the supplier's performance outcome will affect both the buyer's negative WOM intention and the buyer's relationship commitment to the supplier. In particular, when the supplier's performance outcome is poor, the buyer is more likely to engage in a negative WOM action and is less likely to be committed to the supplier. In addition, a muscular approach between the buyer and the supplier will increase the effect of the supplier's performance outcome on the buyer's relationship commitment, while the effects of the supplier's performance outcome on the buyer's negative WOM intention do not differ based on the dyadic governance mechanism adopted by the buyer.

The findings in Study 2 provided an interesting comparison with the findings in Study 1. In Study 1, when the supplier is making a decision on whether to deliver products with a lower quality level than promised in the next shipment, the decision is mostly affected by the individual's internal, psychological concerns, but not the prediction about the buyer's reaction in respect of sharing words with the supplier's potential customers or to cease the relationship with the supplier. However, in the Study 2, we found that the buyer will react to the supplier's performance outcome, i.e., whether the quality of the products received meet their expectations, by both sharing negative experience with the supplier's potential customer when an opportunity presents, and by adjusting its commitment to the supplier in the future. An

interesting implication is that the buyer's embeddedness to the supplier's network should be a critical factor to the supplier when the supplier is making decisions that would affect its performance, as the buyer can and will spread the words, however, the criticality has not been recognized by the supplier.

2.5 General Discussion and Conclusions

In this chapter we hypothesize and find experimental evidence that the network governance mechanisms, in terms of the buyer's embeddedness in the supplier's network, influences a supplier's opportunistic behavioral intention, and that the supplier's performance outcome, as a result of their decision regarding an opportunistic behavior, in turn, influences the buyer's negative WOM intention and its relationship commitment to the supplier. Our study invokes the importance of understanding the effect of network embeddedness on a particular dyad within the network, and provides a behavioral model that can be built upon by future research.

2.5.1 Theoretical Implications

There are several theoretical implications resulting from our findings. First of all, in Study 1, we investigated the effect of dyadic and network governance mechanisms on the supplier's opportunistic behavioral intention and found that the effect of the network governance mechanisms, which has been overlooked in most buyer-supplier studies, is generally supported; while the effect of dyadic governance mechanisms, which has drawn more attention in the previous studies, is not supported. While dyadic governance mechanisms dominate the buyer-supplier and inter-organizational governance literature, the network governance or embeddedness, should be considered and investigated in future studies.

In a similar manner, this chapter pushed the boundaries of Agency Theory and

TCE by examining buyer-supplier issues beyond the dyad. While both theories assume supplier (or agent) opportunism and focus on mechanisms, as such monitoring, providing incentives, or vertical integration, in order to alleviate the supplier's opportunistic behavior, the mechanism of embeddedness has been overlooked. Building upon the network governance theory, we provided experimental evidence that the mechanism of embeddedness is effective in reducing the supplier's opportunistic behavioral intention.

In addition, the behavioral experiments developed in this chapter has provided further details on how network embeddedness could affect the supplier's opportunistic behavioral intention. In particular, we hypothesized three types of perceived costs through which the network embeddedness could be effective. While most of the supply chain management and inter-organizational studies focused on organizational-level constructs such as the impact of the buyer-supplier relationship on the buyer's firm-level performance, the detailed information on how individuals within the organization make decisions is usually overlooked. This study contributed to behavioral supply chain management literature by combining inter-organizational governance and social psychology literature to investigate how the presence of embeddedness would affect the decision maker's perceptions and predictions, and thus influence their behavioral intentions.

Lastly, this chapter proposed an alternative mechanism of network governance. While the theory suggests that network governance could curve the supplier's behavior through social mechanisms, such as macro-culture, collective sanctions, and reputation (Jones et al., 1997) which all evolve over a relatively long period of time and are considered evolutionary (Axelrod, 1986, 1987; Nowak and Sigmund, 1998; Burtsev and Turchin, 2006; Boyd et al., 2003), our research proposed that the effect of network governance can be instantaneous. We incorporated social psychology

literature in the development of hypotheses and found support in the experiments.

2.5.2 Managerial Implications

Our findings highlight the importance of network governance in addressing issues within a buyer-supplier dyad. In addition to the dyadic level strategies, such as supplier integration or building long-term relationships, the buyer could also consider the mechanisms of network governance in order to address issues with a supplier. This network governance mechanism could outperform traditional dyadic strategies in that it does not necessarily create hostility within the buyer-supplier relationship, and that the buyer's connections to the supplier's network is likely to exist directly or indirectly already through inter-organization and inter-personal networks, but may not have been utilized for supplier management purposes. Therefore, our research proposed a new approach for buyers to solve problems with certain suppliers.

In addition, our findings revealed that the effect of network embeddedness on reducing the supplier's opportunistic behavioral intention is mediated by the supplier's negative affection prediction, but not the perceived buyer's reactions. This finding interestingly implies that the supplier's awareness of the buyer's embeddedness creates a credible threat in the supplier's mind that immediately decrease the his/her opportunistic behavioral intention. In this case, the buyer does not have to engage in real actions such as terminating the contract or "bad mouthing" the supplier, but simply makes the supplier aware of the buyer's connections. This is similar to "the shadow of the future" which is that opportunistic behavior is largely reduced if the possibility of future business is high. Therefore, we call it the "shadow of network" that refers to a reduction in opportunistic behavior if the possibility of a referral, positive or negative, is high.

Our research also has implications for the suppliers. In particular, our findings in

Study 2 reveal that the buyers are more likely to engage in negative WOM activities when an opportunity presents and to reduce the level of commitment with the supplier if the supplier's performance did not meet the buyer's expectations. However, the findings in Study 1 imply that the suppliers usually overlook the buyers' reactions, and only focus on their own feelings, when they were making decisions on whether to deliver lower quality products than promised. While the level of embeddedness has a direct effect in reducing the supplier's opportunistic behavioral intention, it is not mediated through the negative network-effect prediction, yet, such a prediction is very likely to be "realized" by the buyer if the supplier indeed chooses to behave opportunistically. The implication of this finding is two-fold. First, the negative network-effect does exist but has been ignored when supplier is making decisions. Second, the presence of the direct effect and the absence of the indirect effect implies that the supplier's cognition of the effect of embeddedness might be low, but their intuitions lead them to be more cautious under the high embedded condition. Therefore, although the suppliers may have the intuition to make the right decisions, it is also critical for them to be aware of the buyer's level of embeddedness and to understand the impact.

This research, although conducted in a B2B setting, it has an interesting implication for the B2C environment as well. Enabled by social media and online review systems, the effect of embeddedness is amplified and expanded to the largest extent. The "six degrees of separation" is now shortened via the internet. For example, everyone who uses Facebook is considered embedded in the Facebook network, and everyone who purchases from Amazon.com is considered embedded in Amazon's network. In these virtual networks, online shoppers leave reviews of their purchase experience and check other people's comments before they make purchasing decisions. In the case, the effect of the "shadow of network" is further strengthened because every

customer can leave a review and every review can make an impact. The reviews are especially important in the service industry because it is difficult to assess the quality of service before it is provided and returns are highly unlikely in case of consumer dissatisfaction. This is one of the reasons that crowd-sourced reviews platforms, such as Yelp.com, TripAdvisor.com, and AngiesList.com are so popular in recent years. As a result, there are implications to both the suppliers and online shoppers. On the one hand, the suppliers who supply products or services on the online platform should understand that the potential impact of every transaction is large and thus should be more cautious about their behavior. On the other hand, the online shoppers should be aware of their impact on the supplier and could choose to use the effect of embeddedness to improve its purchase experiences.

2.5.3 Limitation and Future Studies

There are several limitations to this research that must be highlighted to motivate future studies. First of all, our research includes two studies to investigate a buyer-supplier problem from both sides. The benefit of this approach is that we could control for many potential confounding effects by constraining the scenarios provided to the participants. However, a more realistic setting of the study would be a dyadic design in which two subjects participate in the study together, one plays the buyer and the other plays the supplier, while the challenge is that the dyadic setting could create noises and confounding effects during the interaction between the two subjects.

Second, we acknowledge that participants might not fully internalize our experiment's generic descriptions. Although we applied several techniques to ensure the validity of our constructs (e.g., by pretesting and refining the experimental instruments, and by using a quiz to check the participants' understanding of the description), we recognize that the effect of network embeddedness, our main interest, is a relatively

unfamiliar and abstract factor for the managers. In future studies, the experiment could include multiple participants, some play the buyers and others play the suppliers, so that the level of embeddedness could be manipulated by their connectivity, which is more concrete and realistic for the participants.

Third, the dependent variables of both studies in this research are the manager's behavioral intentions, which is highly influential to one's actual behavior. In future studies, the experiment could be designed in a way that the actual behavior could be captured. In line with the previous suggestion, a multiplayer game could be developed to both manipulate the level of embeddedness in a more realistic way and capture the participants' actual behavior.

Finally, although our hypothesized model is partially supported, how the suppliers make decisions regarding whether to engage in an opportunistic behavior is a complex process. Other factors could be considered in future studies, such as the supplier's intuition and other cognitive factors to further understand the mechanism of the effect of embeddedness on the supplier's opportunistic behavior or behavioral intention.

Chapter 3

DIRECTED SOURCING UNDER GOAL INCONGRUENCE: A MULTI-TASK MODEL OF TRIAD

Abstract

Directed sourcing is an emerging supply chain practice in which the buying company, such as an OEM, bypasses its top-tier supplier and directly sources from second-tier suppliers. Anecdotal evidence has shown that OEMs generally benefit from directed sourcing due to a better control over cost, but top-tier suppliers generally resist directed sourcing practices. Although several industry leaders adopted this practice, literature on directed sourcing is rare. Thus, in this dissertation chapter, I formulate a multi-task principal-agent model to investigate the benefits (or lack thereof) of the directed sourcing structure to each of the supply network members, namely an OEM, a top-tier supplier, and a second-tier supplier, in comparison with the traditional tiered sourcing structure, and examine whether the directed sourcing structure benefits the OEM, in comparison with the traditional tiered sourcing structure, under different levels of goal incongruence. The results show that the incentives of the top-tier supplier (or lack thereof) will be transferred to the second-tier supplier under the traditional sourcing structure (a chain effect), while the two suppliers are competing for incentives under the directed sourcing structure (a competition effect). In addition, directed sourcing generally benefits both the OEM and the second-tier supplier, and such benefits increases as the level of goal incongruence decreases at the second-tier supplier's level, and as the level of top-tier supplier's dependency on second-tier supplier increases. On the other hand, the top-tier supplier is generally worse off un-

der the directed sourcing structure because of the loss of power over the second-tier supplier, which is consistent with empirical evidence that top-tier suppliers typically resist implementing directed sourcing. This chapter quantifies the benefits and issues of directed sourcing and identifies goal incongruence and supplier dependency as two critical factors that affect whether and when directed sourcing is beneficial.

3.1 Introduction

After a decade of outsourcing, “manufacturers are delegating too much power to top-tier suppliers and undermining their own ability to innovate, cut costs, and manage risk” (Choi and Linton, 2011, p.2). For example, Boeing, failed to deliver the 787 Dreamliner on time due to the lack of control of its supply chain, especially its low-tier suppliers. The major delay, costing Boeing and its suppliers billions of dollars in penalty payments and cash shortages, was caused by the shortage of fasteners from a second-tier supplier, with whom Boeing had no direct contract (Greising and Johnsson, 2007). In line with this example, research in supply chain risk management found that the failure of low-tier suppliers can have a significant impact on manufacturers, (e.g., Kull and Closs, 2008; Manuj and Mentzer, 2008), and research in supply networks also highlights the criticality of lower-tier suppliers on the buying firm’s financial, operational, and innovation performance (Yan et al., 2015; Mena et al., 2013; Hammami et al., 2014; Grimm et al., 2014). Therefore, industry leaders, such as Apple, Dell, HP, Honda, IBM, LG electronics, and Toyota, have adopted a “directed sourcing” strategy in which they bypass the top-tier suppliers and directly manage or contract with lower-tier suppliers in order to retrieve the competitive advantage and to avoid losing control of their supply chain to the top-tier supplier (Choi and Linton, 2011). In this case, the top-tier suppliers manage the quality and delivery, while the OEMs manage costs and technologies (Choi and Hong, 2002; Choi and Linton, 2011).

While anecdotal evidence has shown that OEMs could benefit from directed sourcing by improving their overall control over their supply networks and that top-tier suppliers tend to resist the implementation of this strategy because of the lack of autonomy, literature in this emerging sourcing strategy is still in its infancy (Kim and Hur, 2015; Yin et al., *aper*). Because of the lack of understanding, companies that follow these industry leaders may fail to realize the benefits or create problems when they implement this strategy. Therefore, this dissertation chapter aims to fill this research gap and promote the understanding of direct sourcing by quantifying the benefits and/or issues of directed sourcing in comparison with tiered sourcing. In particular, I consider a single product supply chain with three members: the OEM, the top-tier supplier, and the second-tier supplier. Multi-task principal-agent model is used to formulate any contractual relationship between the three members and the goal is to compare the payoff of each member under the directed sourcing structure with that under the tiered sourcing structure (Holmstrom and Milgrom, 1991). The difference between directed sourcing model and traditional sourcing model is mainly the contractual structure, within which parties maximize their own payoffs. Therefore, the research questions are whether and under what conditions directed sourcing structure is beneficial to the OEM and the suppliers.

Key findings of this chapter are as follows. First, the incentive term to the top-tier supplier and that to the second-tier supplier are positively related under the traditional tiered sourcing structure (i.e., a chain effect), while they are negatively related under the directed sourcing structure (i.e., a competition effect). Second, in the case that there is no misalignment within any contract (i.e., the no misalignment condition), the OEM can still benefit from the directed sourcing structure when the supplier dependency (i.e., the level of dependency of the top-tier supplier on the second-tier supplier) is high. In addition, the second-tier supplier is always better

off and the top-tier supplier is always worse off in directed sourcing under the no misalignment condition. On the other hand, in the case that the second-tier supplier's performance measures completely misaligned with its true contribution (i.e., the complete misalignment condition), the optimal actions and payoffs of each party in directed sourcing are identical to those in the traditional sourcing. In addition, directed sourcing generally benefits the OEM, and such benefit increases as the top-tier supplier's level of dependency on the second-tier supplier increases, and as the goal incongruence level decreases at the second-tier supplier level.

This dissertation chapter makes several important contributions. First, motivated by the emerging practice of directed sourcing, our study establishes multi-task principal-agent models to examine and quantify the benefits and issues in directed sourcing. While the directed sourcing strategy has been adopted by many industry leaders and is believed to be beneficial, theoretical and analytical work to understand this new practice has been lacking. Importantly, I examine who could benefit from directed sourcing and under which conditions. Second, this study focuses on the impact of goal incongruence at different tiers. I show that while the OEM generally benefits from directed sourcing, such benefit decreases as the goal congruence level increases at the second-tier supplier level. In addition, I also identify that the supplier dependency is an important factor in this study. In particular, I show that the OEM's benefit from directed sourcing increases as the supplier dependency increases.

In the following sections, I first review relative literature on different types of contracts in agency theory literature and different sourcing structures in supply chain literature. I then present the model setups under traditional tiered and directed sourcing structures and compare the payoff of each member under the two structures. Next, I develop two special cases and conduct a numerical analysis to derive further insights. Finally, I conclude the chapter with discussions and suggest future

directions.

3.2 Literature Review

Two streams of research are relevant to our study. The first stream is derived from agency theory and studies agency problems in a transaction relationship. In its essence, agency theory is developed to study “the ubiquitous agency relationship, in which one party (principal) delegates work to another party (the agent), who performs that work” (Eisenhardt, 1989, p.58). According to this theory (Eisenhardt, 1989), the major problem can occur in agency relationships is that the principal cannot verify what the agent is doing, and the principal needs to choose the “most efficient contract” to reduce the agency’s opportunistic behaviors. Although it has originally been applied to the board-CEO relationship, in which the board is the principal and the CEO is the agent, it has also been widely applied to buyer-supplier relationships in supply chain management studies (e.g. Melnyk et al., 2004; Rossetti and Choi, 2008; Balakrishnan et al., 2008). In most cases, because the buyer pays the suppliers to produce parts or provide services for further processes on the buyer’s behalf, the buyer is considered the principal and the supplier the agent (e.g., Rungtusanatham et al., 2007; Melnyk et al., 2004; Rossetti and Choi, 2008).

One way to improve the effectiveness of a contract is to provide incentives to the agent by using an incentive term in addition to a fixed salary. In this case, the two parties sign a linear incentive contract with wage (w) based on the base salary (s) and the incentive term, where s is fixed according to the industry standard and the incentive term is composed of the bonus rate (b , determined by the principal) and the outcome of the contract. Ideally, the incentive term should be based on the agent’s true contribution (y) to the principal, which reflects everything the principal cares about, except for the wage which is determined by the market and is a common

knowledge to each party. In this case, $w = s + by$. However, the contribution is not always measurable. For example, the principal is likely to benefit from parts at a higher quality, but the value of the high quality part could be difficult to access or could not be accessed at the point of delivery. Thus, “objective contracts” (i.e., court-enforceable contracts) based on alternative performance measures and “relational contracts” (i.e., self-enforcing agreements perhaps based on total contribution) are two alternatives for the perfect measurable contracts (Gibbons, 2005). Because the former one is more commonly used in practice (Holmstrom and Milgrom, 1991), I adopt this approach in this study. Under this type of contract, the principal uses alternative performance measures, such as the number of units produced, with limited adjustment made for quality, timely delivery, and so on, as a proxy of the agent’s contribution. These performance measures are objective so that they can be easily assessed by both parties and by the court.¹

Although with the obvious advantage, i.e., easy to implement, this type of contract has a drawback: if the objective performance measures do not perfectly align with the true contribution, this type of contract creates goal incongruence between the principal and the agent because the agent’s objective is to increase its performance while the principal’s desire is to increase the agent’s contribution. In particular, let p denote such a performance measure and consider a linear incentive contract $w = s + bp$. For any given b , the agent’s incentives are to produce a high value of p , while the principal benefits from increased realizations of the agent’s total contribution y . The divergence between the agent’s incentive to increase p and the principal’s desire to increase y is referred to as goal incongruence in agency theory. Such imperfect measurement and goal incongruence are inevitable in any buyer-supplier relationship. While studies

¹Other types of incentives, such as relational contracts, career concerns, and investing in capabilities, have also been adopted in practice and been studied in literature. I refer to Gibbons (2005) for a good review of agency model and incentive issues.

have demonstrate that the use of this type of contracts generates goal incongruence (also called “distortion”) and the impact on contract design, asset ownership and job design (Holmstrom and Milgrom, 1991; Baker, 1992, 2002), it is unknown that how this goal incongruence can affect other supply chain members under different supply chain structures. Therefore, I adopt this approach and expand the context into supply chain triads to quantify the potential benefits for implementing the directed sourcing strategy.

The second stream studies different supply chain structures. For example, Guo et al. (2010) consider three outsourcing structures, namely consignment (similar to our directed sourcing), turnkey with integration, and turnkey (similar to our traditional tiered sourcing), in a three-tier supply chain and focus on how different structures affect the information flow in the supply chain. In addition, Kayis et al. (2013) consider delegation (similar to our traditional tiered sourcing) and control (similar to our directed sourcing) in procurement in a three-tier supply chain assuming the News-vendor formulation and find that the degree of manufacturer’s prior information on the suppliers’ costs determines whether delegation or control is preferable. While both studies compare different structures in a three-tier supply chain as our study, they both focus on the information asymmetry and information flow and the impact of information on each party’s decision and payoffs. Our study, instead, focuses on the goal incongruence between the supply chain parties and compares each party’s profit under the two structures.

3.3 Model Setups

I consider a three-tier supply chain that consists three parties, a manufacturer (M), a top-tier supplier who supplies parts (P) and a second-tier supplier who supplies raw material (R). The relationship among these three parties is modeled in a multi-task

principal-agent setting. In particular, under the traditional tiered sourcing structure, there are two contracts, one between M and P, and the other between P and R. In this case, M is the principal and P is the agent in the M-P contract; and P is the principal and R is the agent in the P-R contract. Under the directed sourcing structure, there are also two contracts, one between M and P, and the other between M and R. Thus, M is the principal in both contracts, and P and R are the agents in the M-P and M-R contract, respectively. I use subscript M, P, and R to denote the variables associated with each of the three parties.

Regardless of the structure, there are two actions (a_{R1} and a_{R2}) that R can choose. The cost function $c(a_{R1}, a_{R2})$ is specified as

$$c(a_{R1}, a_{R2}) = \frac{1}{2}a_{R1}^2 + \frac{1}{2}a_{R2}^2$$

Both actions impact R's true contribution y_R and measured performance p_R . In particular,

$$\begin{aligned} y_R &= f_{R1}a_{R1} + f_{R2}a_{R2} + \varepsilon_R \\ p_R &= g_{R1}a_{R1} + g_{R2}a_{R2} + \phi_R \end{aligned}$$

where $f_{R1}, f_{R2}, g_{R1}, g_{R2} \geq 0$, and ε_R and ϕ_R are events beyond the agent's control occur that affect output and performance respectively, and are normally distributed with zero mean and variance $\sigma_{\varepsilon_R}^2$ and $\sigma_{\phi_R}^2$, respectively.

Due to the difficulty in measuring R's true contribution y_R , the measured performance p_R is used in the compensation term instead. There are two components of R's compensation, a fixed salary s_R , a public knowledge determined by the market, and a linear incentive term $b_R p_R$ where the bonus rate b_R is specified in the contract, and the performance p_R is measured after R fulfills the contract. To illustrate the issue

of goal incongruence caused by imperfect measurement, consider the case in which $y_R = a_{R1} + a_{R2}$ and $p_R = a_{R1}$ (i.e., $f_{R1} = f_{R2} = g_{R1} = 1$ and $g_{R2} = 0$). In this case, a contract based on p_R cannot create incentives for a_{R2} and so misses this potential contribution to y_R . In contrast, if $y_R = a_{R1}$ and $p_R = a_{R1} + a_{R2}$, the contract based on p_R creates an incentive for R to take action a_{R2} , even though a_{R2} is irrelevant to R's total contribution. Finally, in an extreme case such as $y_R = a_{R1} + \varepsilon$ and $p_R = a_{R2} + \phi$, the contract $w_R = s_R + b_R p_R$ creates no value at all to the principal due to the goal incongruence.

Similarly, there are two actions (a_{P1} and a_{P2}) that P can choose, and the cost function $c(a_{P1}, a_{P2})$ is also specified as

$$c(a_{P1}, a_{P2}) = \frac{1}{2}a_{P1}^2 + \frac{1}{2}a_{P2}^2$$

Because P depends on R's raw material to produce the parts, P's true contribution y_P and measured performance p_P not only depend on P's actions, but also R's contribution y_R . Therefore, we have

$$y_P = f_{P1}a_{P1} + f_{P2}a_{P2} + f_{P3}y_R + \varepsilon_P$$

$$p_P = g_{P1}a_{P1} + g_{P2}a_{P2} + g_{P3}y_R + \phi_P$$

where $f_{P1}, f_{P2}, f_{P3}, g_{P1}, g_{P2}, g_{P3} \geq 0$, and ε_P and ϕ_P are events beyond the agent's control occur that affect output and performance respectively, and are normally distributed with zero mean and variance $\sigma_{\varepsilon_P}^2$ and $\sigma_{\phi_P}^2$, respectively.

There are also two components of P's compensation, a fixed salary s_P , a public knowledge determined by the market, and a linear incentive term $b_P p_P$ where the bonus rate b_P is specified in the contract, and the performance p_P is measured after P fulfills the contract. Goal incongruence also exists at P.

To analyze traditional and directed sourcing models, I first set up the model in traditional sourcing and solve each party's problem. I then set up and solve problems in the directed sourcing model and compare the payoffs of each party under the two structures.

3.3.1 Traditional Sourcing Model

In traditional sourcing model, the events are as follows.

- 1) M and P sign a compensation contract, $w_{MP} = s_P + b_{MP}p_P$.
- 2) P and R sign a compensation contract, $w_{PR} = s_R + b_{PR}p_R$.
- 3) R chooses actions (a_{R1} and a_{R2}) which P cannot observe these choices and deliver the raw material to P.
- 4) P pays R the compensation specified by the contract.
- 5) P chooses actions (a_{P1} and a_{P2}) which M cannot observe these choices and deliver the parts to M.
- 6) M pays P the compensation specified by the contract.

In addition, I assume every party is risk-neutral in this model. Under this assumption, each party chooses the level of actions (as an agent) and the bonus rate (as a principal) to maximize the expected payoff. In particular, I solve the problem by first determining the optimal actions for R (a_{R1} and a_{R2}) for any given bonus rate (b_{PR}), then determining the optimal b_{PR} given R's optimal actions and the optimal actions for P (a_{P1} and a_{P2}) for any given bonus rate (b_{MP}); and finally, determining the optimal b_{MP} given P's optimal actions.

First, for any given bonus rate b_{PR} , R maximizes its expected payoff $E(w_{PR}) - c(a_{R1}, a_{R2})$ by determining its two actions a_{R1} and a_{R2} . Solving R's problem, we have $a_{R1}^* = b_{PR}g_{R1}$ and $a_{R2}^* = b_{PR}g_{R2}$, and the R's expected payoff at optimal solution is

$$\Pi_R^* = s_{PR} + \frac{1}{2}b_{PR}^2(g_{R1}^2 + g_{R2}^2). \quad (3.1)$$

Next, I solve the problem of P who is both the principal in the P-R relationship and the agent in the M-P relationship. In this case, P will choose b_{PR} and the actions a_{p1} and a_{p2} jointly to maximize its expected payoff $E(w_{MP}) - c(a_{P1}, a_{P2}) - E(w_{PR})$. Solving P's problem, we have

$$\begin{aligned} a_{P1}^* &= b_{MP}g_{P1} \\ a_{P2}^* &= b_{MP}g_{P2} \\ b_{PR}^* &= \frac{b_{MP}g_{P3}(f_{R1}g_{R1} + f_{R2}g_{R2})}{2(g_{R1}^2 + g_{R2}^2)} \end{aligned}$$

Let $\vec{f}_R = (f_{R1}, f_{R2})$, $\vec{g}_R = (g_{R1}, g_{R2})$, and θ_R be the angle between \vec{f}_R and \vec{g}_R , we have

$$\begin{aligned} b_{PR}^* &= \frac{b_{MP}g_{P3} \vec{f}_R \cdot \vec{g}_R}{2 \|\vec{g}_R\|^2} \\ &= \frac{b_{MP}g_{P3}}{2} \frac{\|\vec{f}_R\|}{\|\vec{g}_R\|} \cos \theta_R \end{aligned} \quad (3.2)$$

where $\frac{\|\vec{f}_R\|}{\|\vec{g}_R\|}$ and $\cos(\theta_R)$ reflects the scaling and alignment of R's true contribution and measured performance respectively (Gibbons, 2005).

From equation (2), the optimal b_{PR} , the bonus rate of the P-R contract, depends on the scale $\frac{\|\vec{f}_R\|}{\|\vec{g}_R\|}$ and the alignment $\cos(\theta_R)$ so that it is the highest when $\cos(\theta_R)=1$, i.e, R's performance and contribution is perfectly aligned. The optimal b_{PR} also depends on b_{MP} , the bonus rate of the M-P contract, and g_{P3} , the coefficient reflecting how much the performance of P depend on the contribution of R. b_{PR}^* is increasing on g_{P3} indicating that when the performance of P is highly dependent on the contribution of R, P will pay R a larger bonus rate. In addition, b_{PR}^* is increasing on b_{MP}^* indicating

that when M increase the bonus rate to P, P is likely to transfer this increase to R. This “chain effect” is common seen in practice: when manufacture gradually squeeze the top-tier supplier’s profit by reducing the bonus rate, the top-tier supplier will also transfer this reduction to the second-tier suppliers. The second-tier suppliers are facing the risk of bankruptcy if they do not have much buffer to absorb the squeeze of their profits.

Therefore, P’s expected payoff at optimal solution is

$$\Pi_P^* = s_{MP} - s_{PR} + \frac{1}{2}b_{MP}^2(g_{P1}^2 + g_{P2}^2 + \frac{g_{P3}^2(f_{R1}g_{R1} + f_{R2}g_{R2})^2}{2(g_{R1}^2 + g_{R2}^2)}) \quad (3.3)$$

For M, the dynamic is similar to typical principal in a dyadic model while take into consideration that p_P and y_P are both dependent to y_R . Knowing the optimal actions of P and R given any bonus rate b_{MP} , the principal can choose a optimal b_{MP} to maximize it’s own payoff $E(y_P - w_{MP})$. Solving M’s problem, we have

$$b_{MP}^* = \frac{2(g_{R1}^2 + g_{R2}^2)(f_{P1}g_{P1} + f_{P2}g_{P2}) + g_{P3}f_{P3}(f_{R1}g_{R1} + f_{R2}g_{R2})^2}{4(g_{R1}^2 + g_{R2}^2)(g_{P1}^2 + g_{P2}^2) + 2g_{P3}^2(f_{R1}g_{R1} + f_{R2}g_{R2})^2}$$

Let $\alpha^2 = \frac{(f_{R1}g_{R1} + f_{R2}g_{R2})^2}{2(g_{R1}^2 + g_{R2}^2)}$, $\vec{f}_P = (f_{P1}, f_{P2}, \alpha f_{P3})$, $\vec{g}_P = (g_{P1}, g_{P2}, \alpha g_{P3})$, and θ_P be the angle between \vec{f}_P and \vec{g}_P , we have

$$\begin{aligned} b_{MP}^* &= \frac{1}{2} \frac{f_{P1}g_{P1} + f_{P2}g_{P2} + \alpha^2 g_{P3}f_{P3}}{g_{P1}^2 + g_{P2}^2 + \alpha^2 g_{P3}^2} \\ &= \frac{1}{2} \frac{\|\vec{f}_P\|}{\|\vec{g}_P\|} \cos \theta_P \end{aligned} \quad (3.4)$$

where α is $\frac{1}{\sqrt{2}}$ of the length of the projection of \vec{f}_R on \vec{g}_R which increases in the scale $\frac{\|\vec{f}_R\|}{\|\vec{g}_R\|}$ and in the alignment $\cos(\theta_R)$. In this case, $\alpha = 0$ when $\cos \theta_R = 0$, i.e., \vec{f}_R and \vec{g}_R are orthogonal; and $\alpha = \frac{1}{\sqrt{2}} \frac{\|\vec{f}_R\|}{\|\vec{g}_R\|}$ when $\theta_R = 0$ ($\cos \theta_R = 1$), i.e., under perfect measurements.

M's expected payoff at optimal solution is

$$\Pi_M^* = \frac{\|\vec{f}_P\|^2}{4}(\cos \theta_P)^2 - s_{MP} \quad (3.5)$$

Substitute (4) to (3), we have

$$\Pi_P^* = s_{MP} - s_{PR} + \frac{\|\vec{f}_P\|^2}{8}(\cos \theta_P)^2 \quad (3.6)$$

Besides the salaries, s_{MP} and s_{PR} , which are determined by the market, the P's profit is 1/2 of M's profit. Both profits increase in $\|\vec{f}_P\|$ and $\cos \theta_P$. In particular, when $\theta_P = 0$, i.e., P's performance measures and its true contribution are perfectly aligned, both M and P achieve the maximum profits.

Substitute (2) and (4) to (1), we have

$$\Pi_R^* = s_{PR} + \frac{1}{32} \frac{g_{P3}^2}{\|\vec{g}_P\|^2} (\|\vec{f}_R\| \|\vec{f}_P\| \cos \theta_R \cos \theta_P)^2 \quad (3.7)$$

According to (7), R's profit increases in $\frac{g_{P3}^2}{\|\vec{g}_P\|^2}$, which is the weight of R's performance on P's overall performance. It also increases in $\|\vec{f}_R\|$ and $\|\vec{f}_P\|$, the length of \vec{f}_R and \vec{f}_P , and decreases in θ_R and θ_P .

3.3.2 Directed Sourcing Model

In the directed sourcing model, the events are as follows.

1) M signs contract with P and R separately at the compensation of $w_{MP} = s_P + b_{MP}p_P$, and $w_{PR} = s_R + b_{PR}p_R$ respectively.

2) P chooses actions (a_{P1} and a_{P2}) and R chooses actions (a_{R1} and a_{R2}), both sets of actions cannot be observed by M.

3) M pays P and R the compensation specified by the contracts.

Again, I assume every party is risk-neutral. To solve the problem, I first find the optimal actions for R (a_{R1} and a_{R2}) for any given bonus rate (b_{PR}), and the optimal actions for P (a_{P1} and a_{P2}) for any given bonus rate (b_{MP}); then I find the optimal b_{MP} and b_{MR} jointly for M given P's and R's optimal actions.

I first look at the problem of R. Since R is simply the agent in the M-R contractual relationship, we have $a'_{R1} = b_{MR}g_{R1}$ and $a'_{R2} = b_{MR}g_{R2}$, and the R's expected payoff and output at optimal solution are

$$\Pi'_R = s_{MR} + \frac{1}{2}b_{MR}^2(g_{R1}^2 + g_{R2}^2). \quad (3.8)$$

$$y'_R = b_{MR}(f_{R1}g_{R1} + f_{R2}g_{R2}) + \varepsilon_R \quad (3.9)$$

For P, although it is also simply the agent in the M-P contractual relationship, it's performance depends on the contribution of R. P chooses the actions a_{P1} and a_{P2} to maximize the expected payoff $E(w_{MP}) - c(a_{P1}, a_{P2})$ given b_{MP} and y_R . Solving P's problem, we have

$$a'_{P1} = b_{MP}g_{P1}$$

$$a'_{P2} = b_{MP}g_{P2}$$

And P's expected payoff and expected contribution at optimal solution are

$$\Pi'_P = s_{MP} + \frac{1}{2}b_{MP}^2(g_{P1}^2 + g_{P2}^2) + b_{MP}g_{P3}y_R \quad (3.10)$$

$$y'_P = b_{MP}(f_{P1}g_{P1} + f_{P2}g_{P2}) + f_{P3}y'_R \quad (3.11)$$

For M, it is the principal in both M-P and M-R contractual relationships. Knowing

the optimal actions of P and R given any bonus rate b_{MP} and b_{MR} , M can choose b_{MP} and b_{MR} to maximize it's own payoff $E(y_P - w_{MP} - w_{MR})$.

$$\begin{aligned}
\max_{b_{MR}, b_{MP}} \Pi_M &= E(y_P - w_{MP} - w_{MR}) \\
&= b_{MP}(f_{P1}g_{P1} + f_{P2}g_{P2}) + b_{MR}f_{P3}(f_{R1}g_{R1} + f_{R2}g_{R2}) \\
&\quad - b_{MP}^2(g_{P1}^2 + g_{P2}^2) - b_{MP}b_{MR}g_{P3}(f_{R1}g_{R1} + f_{R2}g_{R2}) \\
&\quad - b_{MR}^2(g_{R1}^2 + g_{R2}^2) - s_{MP} - s_{MR}
\end{aligned}$$

To solve M's problem, assuming the Hessian matrix is negative definite:

$$4(g_{R1}^2 + g_{R2}^2)(g_{P1}^2 + g_{P2}^2) - g_{P3}^2(f_{R1}g_{R1} + f_{R2}g_{R2})^2 > 0, \text{ we have}$$

$$b'_{MP} = \frac{f_{P1}g_{P1} + f_{P2}g_{P2} - f_{P3}g_{P3}\alpha^2}{2(g_{P1}^2 + g_{P2}^2) - g_{P3}^2\alpha^2} \quad (3.12)$$

$$b'_{MR} = \frac{\vec{f}_R \cdot \vec{g}_R}{2\|\vec{g}_R\|^2} \left(f_{P3} - g_{P3} \frac{f_{P1}g_{P1} + f_{P2}g_{P2} - f_{P3}g_{P3}\alpha^2}{2(g_{P1}^2 + g_{P2}^2) - g_{P3}^2\alpha^2} \right) \quad (3.13)$$

And

$$b'_{MR} = (f_{P3} - b'_{MP}g_{P3}) \frac{(f_{R1}g_{R1} + f_{R2}g_{R2})}{2(g_{R1}^2 + g_{R2}^2)} \quad (3.14)$$

Unlike in the traditional tiered sourcing model, b'_{MR} decreases as b'_{MP} increases. In this case, P does not transfer the incentives to R, but instead competes with R. Therefore, the directed sourcing structure creates a “competition effect” between P and R.

Proposition 1: *In the directed sourcing model, $\frac{\partial b'_{MR}}{\partial b'_{MP}} < 0$, while in the traditional tiered sourcing model, $\frac{\partial b_{PR}^*}{\partial b_{MP}^*} > 0$.*

Proposition 1 demonstrates that the bonus rates for P and R are positively related under the traditional tiered sourcing structure, but are negatively related under the

directed sourcing structure. This finding implies that rewards and risks will be transferred to the lower-tier supplier through the top-tier supplier under the traditional sourcing structure, while the two suppliers, although at different tiers, are competing for rewards under the directed sourcing structure.

For P, we compare the two decision variables (a_{P1}^*, a_{P2}^*) with (a'_{P1}, a'_{P2}) under the two different structures. Since the only difference between (a_{P1}^*, a_{P2}^*) and (a'_{P1}, a'_{P2}) is the bonus coefficients, b_{MP}^* and b'_{MP} , we can compare b_{MP}^* with b'_{MP} .

$$\begin{aligned} b'_{MP} - b_{MP}^* &= \frac{f_{P1}g_{P1} + f_{P2}g_{P2} - f_{P3}g_{P3}\alpha^2}{2(g_{P1}^2 + g_{P2}^2) - g_{P3}^2\alpha^2} - \frac{f_{P1}g_{P1} + f_{P2}g_{P2} + \alpha^2 g_{P3}f_{P3}}{2(g_{P1}^2 + g_{P2}^2 + \alpha^2 g_{P3}^2)} \\ &= \frac{\left(\frac{\vec{f_P} \cdot \vec{g_P}}{2\|\vec{g_P}\|^2} 3g_{P3} - 2f_{P3} \right) g_{P3}\alpha^2}{2\|\vec{g_P}\|^2 - 3g_{P3}^2\alpha^2} \end{aligned}$$

In this case, if $g_{P3} = 0$ (i.e., P's performance does not depend on R's Output) or $\alpha^2 = 0$ (i.e, $\cos \theta_R = 0$, R's performance is orthogonal to R's output), the two bonus coefficients are the same. If $g_{P3} \neq 0$ and $\alpha^2 \neq 0$, we have

$$b'_{MP} - b_{MP}^* = \frac{\frac{3}{4} \frac{\vec{f_P} \cdot \vec{g_P}}{\|\vec{g_P}\|^2} - \frac{f_{P3}}{g_{P3}}}{\frac{\|\vec{g_P}\|^2}{g_{P3}^2\alpha^2} - \frac{3}{2}}$$

Therefore, we have

Proposition 2:

$$\left\{ \begin{array}{l} b'_{MP} - b_{MP}^* = 0, \quad \text{if } g_{P3} = 0 \text{ or } \alpha^2 = 0 \\ b'_{MP} - b_{MP}^* > 0, \quad \text{if } \frac{3}{4} \frac{\vec{f_P} \cdot \vec{g_P}}{\|\vec{g_P}\|^2} - \frac{f_{P3}}{g_{P3}} > 0 \text{ and } \frac{\|\vec{g_P}\|^2}{g_{P3}^2\alpha^2} - \frac{3}{2} > 0, \text{ or} \\ \quad \text{if } \frac{3}{4} \frac{\vec{f_P} \cdot \vec{g_P}}{\|\vec{g_P}\|^2} - \frac{f_{P3}}{g_{P3}} < 0 \text{ and } \frac{\|\vec{g_P}\|^2}{g_{P3}^2\alpha^2} - \frac{3}{2} < 0; \\ b'_{MP} - b_{MP}^* < 0, \quad \text{if otherwise.} \end{array} \right.$$

Proposition 2 demonstrates that P's bonus rate could be higher under the directed sourcing structure than under the traditional sourcing structure, which implies that P is not always worse off in the directed sourcing practice, so some resistance from top-tier supplier during the implementation of directed sourcing practices can be unnecessary.²

Similarly, for R, we can simply compare the bonus coefficients for R, b_{PR}^* and b'_{MR} ,

$$b'_{MR} - b_{PR}^* = \frac{\vec{f}_R \cdot \vec{g}_R}{2 \|\vec{g}_R\|^2} \left[f_{P3} - g_{P3} \left(\frac{2\vec{f}_P \cdot \vec{g}_P - (2f_{P3}g_{P3}\alpha^2) - \frac{\vec{f}_P \cdot \vec{g}_P}{2\|\vec{g}_P\|^2} (3g_{P3}^2\alpha^2)}{(2\|\vec{g}_P\|^2 - 3g_{P3}^2\alpha^2)} \right) \right]$$

In this case, if $\vec{f}_R \cdot \vec{g}_R = 0$, $b'_{MR} = b_{PR}^* = 0$. R makes no actions and has zero bonus under either structure. If $\vec{f}_R \cdot \vec{g}_R \neq 0$ and $g_{P3} = 0$, i.e., P's performance does not depend on R's Output, $b'_{MR} > b_{PR}^*$ always hold. R has higher level of actions and profit under the directed sourcing structure than tiered sourcing structure.

Proposition 3: $b'_{MR} > b_{PR}^*$ and $\Pi'_R > \Pi_R^*$ if $\vec{f}_R \cdot \vec{g}_R \neq 0$ and $g_{P3} = 0$.

Proposition 3 demonstrates that R always has higher bonus rate and profit under the directed sourcing structure than the tiered sourcing structure if R's performance measures is not completely misaligned and P's performance measures do not take R's contribution into consideration.

If $\vec{f}_R \cdot \vec{g}_R \neq 0$ and $g_{P3} \neq 0$,

$$b'_{MR} - b_{PR}^* = \frac{\vec{f}_R \cdot \vec{g}_R}{2 \|\vec{g}_R\|^2} f_{P3} \left[1 - \frac{2\frac{\vec{f}_P \cdot \vec{g}_P}{f_{P3}g_{P3}\alpha^2} - 2 - 3\frac{\vec{f}_P \cdot \vec{g}_P}{2\|\vec{g}_P\|^2} \frac{g_{P3}}{f_{P3}}}{\left(2\frac{\|\vec{g}_P\|^2}{g_{P3}^2\alpha^2} - 3 \right) \frac{g_{P3}}{f_{P3}}} \right]$$

For M, its payoff under optimal solution is

²Note that $g_{P3} = 0$ or $\alpha^2 = 0$ is a sufficient but not necessary condition for $b'_{MP} - b_{MP}^* = 0$.

$$\begin{aligned}
\Pi'_M = & \frac{f_{P1}g_{P1} + f_{P2}g_{P2} - f_{P3}g_{P3}\alpha^2}{2(g_{P1}^2 + g_{P2}^2) - g_{P3}^2\alpha^2} (f_{P1}g_{P1} + f_{P2}g_{P2}) \\
& + \frac{\vec{f}_R \cdot \vec{g}_R}{2\|\vec{g}_R\|^2} (f_{P3} - g_{P3} \frac{f_{P1}g_{P1} + f_{P2}g_{P2} - f_{P3}g_{P3}\alpha^2}{2(g_{P1}^2 + g_{P2}^2) - g_{P3}^2\alpha^2}) f_{P3} (f_{R1}g_{R1} + f_{R2}g_{R2}) \\
& - \left(\frac{f_{P1}g_{P1} + f_{P2}g_{P2} - f_{P3}g_{P3}\alpha^2}{2(g_{P1}^2 + g_{P2}^2) - g_{P3}^2\alpha^2} \right)^2 (g_{P1}^2 + g_{P2}^2) \\
& - \frac{\vec{f}_P \cdot \vec{g}_P - 2f_{P3}g_{P3}\alpha^2}{2(g_{P1}^2 + g_{P2}^2) - g_{P3}^2\alpha^2} \frac{\vec{f}_R \cdot \vec{g}_R}{2\|\vec{g}_R\|^2} (f_{P3} - g_{P3} \frac{\vec{f}_P \cdot \vec{g}_P - 2f_{P3}g_{P3}\alpha^2}{2(g_{P1}^2 + g_{P2}^2) - g_{P3}^2\alpha^2}) g_{P3} \vec{f}_R \cdot \vec{g}_R \\
& - \left(\frac{\vec{f}_R \cdot \vec{g}_R}{2\|\vec{g}_R\|^2} (f_{P3} - g_{P3} \frac{f_{P1}g_{P1} + f_{P2}g_{P2} - f_{P3}g_{P3}\alpha^2}{2(g_{P1}^2 + g_{P2}^2) - g_{P3}^2\alpha^2}) \right)^2 (g_{R1}^2 + g_{R2}^2) - s_{MP} - s_{MR}
\end{aligned}$$

Since the expression for M's profit is difficult to interpret, I analyze two special cases in section 4 and conduct numerical analysis in section 5 to gain further insights.

3.4 Special Cases

3.4.1 Case 1: The No Misalignment Condition

In this case, the performances of R and P can be perfectly measured so that $g_i = f_i$, where $i = R1, R2, P1, P2$, and $P3$. In this case, there is no misalignment nor goal incongruence within any contract.

For the tiered sourcing structure,

$$\begin{aligned}
b_{MP}^* &= \frac{1}{2} \frac{f_{P1}g_{P1} + f_{P2}g_{P2} + \alpha^2 g_{P3}f_{P3}}{g_{P1}^2 + g_{P2}^2 + \alpha^2 g_{P3}^2} \\
&= \frac{1}{2} \\
b_{PR}^* &= \frac{b_{MP}g_{P3}}{2} \frac{\vec{f}_R \cdot \vec{g}_R}{\|\vec{g}_R\|^2} \\
&= \frac{1}{4} g_{P3}
\end{aligned}$$

In this case b_{MP}^* is a constant and b_{PR}^* only depends on and increases in g_{P3} .

The profits for the three organizations under the tiered sourcing structure are:

$$\begin{aligned}\Pi_R^* &= s_{PR}^* + \frac{1}{32}g_{P3}^2 (g_{R1}^2 + g_{R2}^2) \\ \Pi_P^* &= s_{MP}^* - s_{PR}^* + \frac{1}{8} \left[(g_{P1}^2 + g_{P2}^2) + \frac{1}{2}g_{P3}^2 (g_{R1}^2 + g_{R2}^2) \right] \\ \Pi_M^* &= \frac{1}{4} (g_{P1}^2 + g_{P2}^2) + \frac{1}{8}g_{P3}^2 (g_{R1}^2 + g_{R2}^2) - s_{MP}^*\end{aligned}$$

In this case, besides the salaries, M's profit is twice that of P's, and P's profit is more than R's.

For the directed sourcing structure, we also assume the Hessian matrix is negative definite:

$4(g_{P1}^2 + g_{P2}^2) - g_{P3}^2 (g_{R1}^2 + g_{R2}^2) > 0$. In this case, we have:

$$\begin{aligned}b'_{MP} &= \frac{f_{P1}g_{P1} + f_{P2}g_{P2} - \frac{1}{2}f_{P3}g_{P3}\alpha^2 - \frac{1}{2}f_{P3}g_{P3}\alpha^2}{2(g_{P1}^2 + g_{P2}^2 - \frac{1}{2}g_{P3}^2\alpha^2)} \\ &= \frac{1}{2} - \frac{g_{P3}^2\alpha^2}{4(g_{P1}^2 + g_{P2}^2 - \frac{1}{2}g_{P3}^2\alpha^2)} \\ &= \frac{1}{2} - \frac{g_{P3}^2 \|g_R\|^2}{8(g_{P1}^2 + g_{P2}^2 - \frac{1}{4}g_{P3}^2 \|g_R\|^2)}\end{aligned}$$

If $g_{P3} = 0$, $b'_{MP} = b_{MP}^* = \frac{1}{2}$, a constant, $b_{PR}^* = b'_{MR} = 0$. No difference in the bonus rates. And the profits of the three organizations will be the same under the two structure.

Proposition 4: If $g_i = f_i$, where $i = R1, R2, P1, P2$, and $P3$ and $g_{P3} = 0$, we have $\Pi_R^* = \Pi'_R$, $\Pi_P^* = \Pi'_P$, and $\Pi_M^* = \Pi'_M$.

Proposition 4 demonstrates that under the no misalignment condition, if P's performance does not depend on R's contribution, each party generates the same profit under the two sourcing structures, i.e., the two structures are indifferent regarding the optimal contract terms and payoffs of each party.

If $g_{P3} \neq 0$,

$$\begin{aligned}
b'_{MP} &= \frac{1}{2} + \frac{\frac{g_{P3}^2 \|g_R\|^2}{g_{P1}^2 + g_{P2}^2}}{2\left(\frac{g_{P3}^2 \|g_R\|^2}{g_{P1}^2 + g_{P2}^2} - 4\right)} \\
b'_{MR} &= \frac{1}{2} g_{P3} (1 - b'_{MP}) \\
&= \frac{1}{4} g_{P3} - \frac{1}{4} g_{P3} \frac{\frac{g_{P3}^2 \|g_R\|^2}{g_{P1}^2 + g_{P2}^2}}{\left(\frac{g_{P3}^2 \|g_R\|^2}{g_{P1}^2 + g_{P2}^2} - 4\right)}
\end{aligned}$$

Let $\beta = \frac{g_{P3}^2 \|g_R\|^2}{g_{P1}^2 + g_{P2}^2}$. Based on the assumption that the Hessian matrix is negative definite, we have $0 < \beta < 4$. In this case, $b'_{MP} < b_{MP}^* = 1/2$, and $b'_{MR} > b_{MR}^* = \frac{1}{4} g_{P3}$. P's bonus coefficient is lower while R's bonus coefficient is higher in the directed sourcing structure. In general, β reflects the ratio of the weights of R's outputs on P's performance/output over the weights of P's own actions, i.e., weight of actions not controlled by P (but by R) vs. weight of actions controlled by P. Therefore, we define β as “the supplier dependency”, which can be considered as the dependency coefficient of P on R. In particular, β is larger when P's performance is more dependent on R's performance, i.e., P is more dependent. Therefore, we have

$$b'_{MP} = \frac{1}{2} + \frac{\beta}{2(\beta - 4)} = \frac{2 - \beta}{4 - \beta} \quad (3.15)$$

$$b'_{MR} = \frac{1}{2} g_{P3} \left(\frac{1}{2} - \frac{\beta}{2(\beta - 4)} \right) = \frac{g_{P3}}{4 - \beta} \quad (3.16)$$

According to (15) and (16), $b'_{MR} > 0$ when $0 < \beta < 4$ (Second-order condition), but b'_{MP} is negative when $2 < \beta < 4$, which is problematic. Therefore, we added to two

nonnegativity constraints to this problem. We now have:

$$\begin{aligned}
\max \Pi_M &= b_{MP}(1 - b_{MP})(g_{P1}^2 + g_{P2}^2) + b_{MR}(1 - b_{MP})g_{P3}^2(g_{R1}^2 + g_{R2}^2) \\
&\quad - b_{MR}^2(g_{R1}^2 + g_{R2}^2) - s_{MP} - s_{MR} \\
&\quad s.t. \\
&\quad b'_{MR} \geq 0 \\
&\quad b_{MP} \geq 0
\end{aligned}$$

Solving the above problem using the Kuhn-Tucker conditions for the modified Lagrangean approach (Osborne, 2007), we have

$$\begin{cases} b'_{MR} = \frac{g_{P3}}{4-\beta} \text{ and } b'_{MP} = \frac{2-\beta}{4-\beta} & \text{if } 0 < \beta < 2 \\ b'_{MR} = \frac{g_{P3}}{2} \text{ and } b'_{MP} = 0 & \text{if } 2 \leq \beta < 4 \end{cases}$$

Under the directed sourcing structure, the profit for R is

$$\Pi'_R = \begin{cases} s'_{PR} + \frac{1}{32}(g_{R1}^2 + g_{R2}^2)g_{P3}^2 + \frac{1}{8}(g_{R1}^2 + g_{R2}^2)g_{P3}^2 \frac{\beta}{2(\beta-4)} \left(\frac{\beta}{2(\beta-4)} - 1 \right), & \text{if } 0 < \beta < 2 \\ s'_{PR} + \frac{1}{8}(g_{R1}^2 + g_{R2}^2)g_{P3}^2, & \text{if } 2 \leq \beta < 4 \end{cases}$$

Therefore, if $0 < \beta < 2$,

$$\begin{aligned}
\Pi_R^* - \Pi'_R &= s_{PR}^* + \frac{1}{32}g_{P3}^2(g_{R1}^2 + g_{R2}^2) - s'_{PR} - \frac{1}{32}g_{P3}^2(g_{R1}^2 + g_{R2}^2) \\
&\quad - \frac{1}{8}(g_{R1}^2 + g_{R2}^2)g_{P3}^2 \frac{\beta}{2(\beta-4)} \left(\frac{\beta}{2(\beta-4)} - 1 \right) \\
&= s_{PR}^* - s'_{PR} + \frac{1}{32}(g_{R1}^2 + g_{R2}^2)g_{P3}^2 \frac{\beta(\beta-8)}{(\beta-4)^2} \\
&< 0
\end{aligned}$$

If $2 \leq \beta < 4$,

$$\begin{aligned}\Pi_R^* - \Pi_R' &= s_{PR}^* + \frac{1}{32}g_{P3}^2 (g_{R1}^2 + g_{R2}^2) - s_{PR}' - \frac{1}{8}g_{P3}^2 (g_{R1}^2 + g_{R2}^2) \\ &< 0\end{aligned}$$

In this case, $\Pi_R^* < \Pi_R'$ for $0 < \beta < 4$, i.e., R is always better off under the directed sourcing structure.

Proposition 5: *If $g_i = f_i$, where $i = R1, R2, P1, P2$, and $P3$, $g_{P3} > 0$, and $0 \leq \beta < 4$, we have $\Pi_R^* < \Pi_R'$.*

Proposition 5 implies that under the no misalignment condition, R is always better off in directed sourcing.

The profit for P is

$$\begin{aligned}\Pi_P' &= s_{MP} + \frac{1}{2}b_{MP}^2(g_{P1}^2 + g_{P2}^2) + b_{MP}b_{MR}g_{P3}(g_{R1}^2 + g_{R2}^2) \\ &= \begin{cases} s_{MP} + \frac{1}{2}\frac{4-\beta^2}{(\beta-4)^2}(g_{P1}^2 + g_{P2}^2), & \text{if } 0 < \beta < 2 \\ s_{MP}, & \text{if } 2 \leq \beta < 4 \end{cases}\end{aligned}$$

Therefore, if $0 < \beta < 2$,

$$\begin{aligned}\Pi_P^* - \Pi_P' &= s_{MP}^* - s_{PR}^* + \frac{1}{8} \left[(g_{P1}^2 + g_{P2}^2) + \frac{1}{2}g_{P3}^2 (g_{R1}^2 + g_{R2}^2) \right] \\ &\quad - s_{MP}' - \frac{1}{2}\frac{4-\beta^2}{(\beta-4)^2}(g_{P1}^2 + g_{P2}^2) \\ &= s_{MP}^* - s_{PR}^* - s_{MP}' + \frac{1}{16}(g_{P1}^2 + g_{P2}^2) \frac{\beta^2(2+\beta)}{(\beta-4)^2}\end{aligned}$$

Assuming $s_{MP}^* - s_{PR}^* - s_{MP}' = 0$ since the salaries are standard, $\Pi_P^* - \Pi_P' \geq 0$ because $\beta > 0$. On the other hand, if $2 \leq \beta < 4$,

$$\Pi_P^* - \Pi_P' = s_{MP}^* - s_{PR}^* + \frac{1}{8} \left[(g_{P1}^2 + g_{P2}^2) + \frac{1}{2}g_{P3}^2 (g_{R1}^2 + g_{R2}^2) \right] - s_{MP}'$$

Again, assuming $s_{MP}^* - s_{PR}^* - s_{MP}' = 0$, we have $\Pi_P^* - \Pi_P' \geq 0$.

Proposition 6: *If $g_i = f_i$, where $i = R1, R2, P1, P2$, and $P3$, $g_{P3} > 0$, and $0 \leq \beta < 4$, we have $\Pi_P^* < \Pi_P'$.*

Proposition 6 demonstrates that if both P and R's contribution can be perfectly measured by the objective performance, P is always worse off in directed sourcing. This proposition is consistent with the empirical evidence that top-tier suppliers typically resist directed sourcing.

The profit for M is

$$\begin{aligned}\Pi_M' &= b_{MP}(1 - b_{MP})(g_{P1}^2 + g_{P2}^2) + b_{MR}(1 - b_{MP})g_{P3}(g_{R1}^2 + g_{R2}^2) \\ &\quad - b_{MR}^2(g_{R1}^2 + g_{R2}^2) - s_{MP} - s_{MR} \\ &= \begin{cases} (g_{P1}^2 + g_{P2}^2) \frac{1}{4-\beta} - s_{MP} - s_{MR}, & \text{if } 0 < \beta < 2 \\ \frac{1}{4}g_{P3}^2(g_{R1}^2 + g_{R2}^2) - s_{MP} - s_{MR}, & \text{if } 2 \leq \beta < 4 \end{cases}\end{aligned}$$

Therefore, if $0 < \beta < 2$,

$$\begin{aligned}\Pi_M^* - \Pi_M' &= \frac{1}{4}(g_{P1}^2 + g_{P2}^2) + \frac{1}{8}g_{P3}^2(g_{R1}^2 + g_{R2}^2) - s_{MP}^* \\ &\quad - (g_{P1}^2 + g_{P2}^2) \frac{1}{4-\beta} + s_{MP}' + s_{MR}' \\ &= s_{MP}' + s_{MR}' - s_{MP}^* + \frac{1}{8}(g_{P1}^2 + g_{P2}^2) \frac{\beta(2-\beta)}{4-\beta}\end{aligned}$$

Assuming $s_{MP}' + s_{MR}' - s_{MP}^* = 0$, $\Pi_M^* - \Pi_M' > 0$ because $\frac{2-\beta}{4-\beta} \geq 0$. On the other hand, if $2 \leq \beta < 4$,

$$\begin{aligned}\Pi_M^* - \Pi_M' &= \frac{1}{4}(g_{P1}^2 + g_{P2}^2) + \frac{1}{8}g_{P3}^2(g_{R1}^2 + g_{R2}^2) - s_{MP}^* - \frac{1}{4}g_{P3}^2(g_{R1}^2 + g_{R2}^2) + s_{MP}' + s_{MR}' \\ &= \frac{1}{8}(g_{P1}^2 + g_{P2}^2)(2-\beta)\end{aligned}$$

Again, assuming $s_{MP}' + s_{MR}' - s_{MP}^* = 0$, we have $\Pi_M^* - \Pi_M' \leq 0$.

Table 3.1: Results in the Special Case of Perfect Alignment Between Any Two Levels

Supplier Dependency (β value)	Low ($0 < \beta < 2$)	High ($2 \leq \beta < 4$)
OEM (M)	-	+
Top-tier Supplier (P)	-	-
Second-tier Supplier (R)	+	+

+: The focal party is better off under the directed sourcing structure than the traditional tiered sourcing structure.

-: The focal party is worse off under the directed sourcing structure than the traditional tiered sourcing structure.

Proposition 7: If $g_i = f_i$, where $i = R1, R2, P1, P2$, and $P3$, and $g_{P3} > 0$,

a. if $2 < \beta < 4$, $\Pi_M^* < \Pi'_M$;

b. if $2 \leq \beta < 4$, $\Pi_M^* \geq \Pi'_M$;

Proposition 7 demonstrates that in the no misalignment condition, M is better off in directed sourcing when the supplier dependency is high ($2 \leq \beta < 4$), and is worse off when the supplier dependency is low ($0 < \beta < 2$).

The results of Propositions 5-7 are summarize in table 3.1. In conclusion, even when there is no goal incongruence within any contract under the no misalignment condition, the directed sourcing strategy can still benefit the OEM when the supplier dependency is high ($2 < \beta < 4$). In addition, R always benefits from directed sourcing, but P is always worse off under the directed sourcing structure.

3.4.2 Case 2: The Complete Misalignment Condition

In the second special case, I examine the other extreme of goal incongruence in which the performance is completely independent to the outputs at any level so that the incentives are completely misaligned. In other words, \vec{f}_R is orthogonal to \vec{g}_R , and

\vec{f}_P is orthogonal to \vec{g}_P under both structures. I also compare the profits of each party under both structures.

For the tiered sourcing structure,

$$\begin{aligned} b_{PR}^* &= 0 \\ b_{MP}^* &= \frac{f_{P1}g_{P1} + f_{P2}g_{P2}}{2(g_{P1}^2 + g_{P2}^2)} \end{aligned}$$

and

$$\begin{aligned} a_{R1}^* &= a_{R2}^* = 0 \\ a_{P1}^* &= g_{P1} \frac{f_{P1}g_{P1} + f_{P2}g_{P2}}{2(g_{P1}^2 + g_{P2}^2)} \\ a_{P2}^* &= g_{P2} \frac{f_{P1}g_{P1} + f_{P2}g_{P2}}{2(g_{P1}^2 + g_{P2}^2)} \end{aligned}$$

Due to the misalignment, M and P will set the bonus rate to zero at the optimal solution, and P and R will choose to have zero level of actions to improve their performance but only engage in minimal effort as required to receive the salary. In this case, the profit of each party is:

$$\begin{aligned} \Pi_R^* &= s_{PR} \\ \Pi_P^* &= s_{MP} - s_{PR} + \frac{1}{8} \frac{(f_{P1}g_{P1} + f_{P2}g_{P2})^2}{(g_{P1}^2 + g_{P2}^2)} \\ \Pi_M^* &= \frac{(f_{P1}g_{P1} + f_{P2}g_{P2})^2}{4(g_{P1}^2 + g_{P2}^2)} - s_{MP} \end{aligned}$$

For directed sourcing structure,

$$\begin{aligned} b'_{MR} &= 0 \\ b'_{MP} &= \frac{f_{P1}g_{P1} + f_{P2}g_{P2}}{2(g_{P1}^2 + g_{P2}^2)} \end{aligned}$$

Since the bonus rates are the same as in the tiered sourcing structure, the action levels and the profits will be the same as well. Therefore, we have

$$\begin{aligned} a'_{R1} &= a'_{R2} = 0 \\ a'_{P1} &= g_{P1} \frac{f_{P1}g_{P1} + f_{P2}g_{P2}}{2(g_{P1}^2 + g_{P2}^2)} \\ a'_P &= g_{P2} \frac{f_{P1}g_{P1} + f_{P2}g_{P2}}{2(g_{P1}^2 + g_{P2}^2)} \end{aligned}$$

and

$$\begin{aligned} \Pi'_R &= s_{PR} \\ \Pi'_P &= s_{MP} - s_{PR} + \frac{1}{8} \frac{(f_{P1}g_{P1} + f_{P2}g_{P2})^2}{(g_{P1}^2 + g_{P2}^2)} \\ \Pi'_M &= \frac{(f_{P1}g_{P1} + f_{P2}g_{P2})^2}{4(g_{P1}^2 + g_{P2}^2)} - s_{MP} \end{aligned}$$

The two structures are indifferent under this extreme condition. The same conclusion can be derived as long as \vec{f}_R is orthogonal to \vec{g}_R . In other words, regardless of \vec{f}_P and \vec{g}_P , if \vec{f}_R is orthogonal to \vec{g}_R , the two structures yield the same profits for each party, i.e., the two structures are indifferent.

Proposition 8: *if \vec{f}_R is orthogonal to \vec{g}_R ($\cos \theta_R = 0$), we have $\Pi_R^* = \Pi'_R$, $\Pi_P^* = \Pi'_P$, and $\Pi_M^* = \Pi'_M$.*

In other words, when R's performance measures are completely orthogonal to its contribution, regardless of P's performance measure, the directed sourcing and tiered sourcing structures yield the same profit for each party.

3.5 Numerical Analysis

To gain further insights from the models, I conduct numerical analysis in this section. First, I examine the impact of the misalignment level for second-tier supplier on

each party's profit under several conditions. Figure 3.1 shows the OEM's profits as a function of θ_R under the traditional sourcing and the directed sourcing structures, where θ_R is the misalignment between R's contribution and its performance measures and ranges from 0 to 90 degrees. The three figures in the first row show OEM's profits under the conditions that the misalignment level for P (the top-tier supplier) is low, while P's performance is highly independent (upper left), moderately dependent (upper middle), and highly dependent (upper right), respectively. The three figures in the second row show OEM's profits under the conditions that the misalignment level for P is high, while P's performance is highly independent (lower left), moderately dependent (lower middle), and highly dependent (lower right), respectively. In general, the results show that, if the misalignment level for P is low, the OEM generates a lower profit under the directed sourcing structure than traditional sourcing, but the difference generally decreases as R's misalignment level increases. On the other hand, if the misalignment level for P is high, the OEM generates a higher profit under the directed sourcing structure than the traditional sourcing structure, and the difference decreases as R's misalignment level increases. In any situation, when R's misalignment level is at the highest ($\theta_R = 90$), the two structures generate the same profit levels for M, which is consistent with the finding in the special case.

Figures 3.2 and 3.3 show P' and R's profits as a function of θ_R under the traditional sourcing and the directed sourcing structures respectively. Both sets of figures follow the same order of conditions as in Figure 3.1. In general, the results show that the top-tier supplier generates a lower profit, while the second-tier supplier generates a higher profit under the directed sourcing structure than the traditional sourcing structure. In addition, the differences decrease as R's misalignment level increases. Therefore, the directed sourcing structure generally benefits both the OEM and the second-tier supplier but harm the top-tier supplier's profit. However, the effect of the

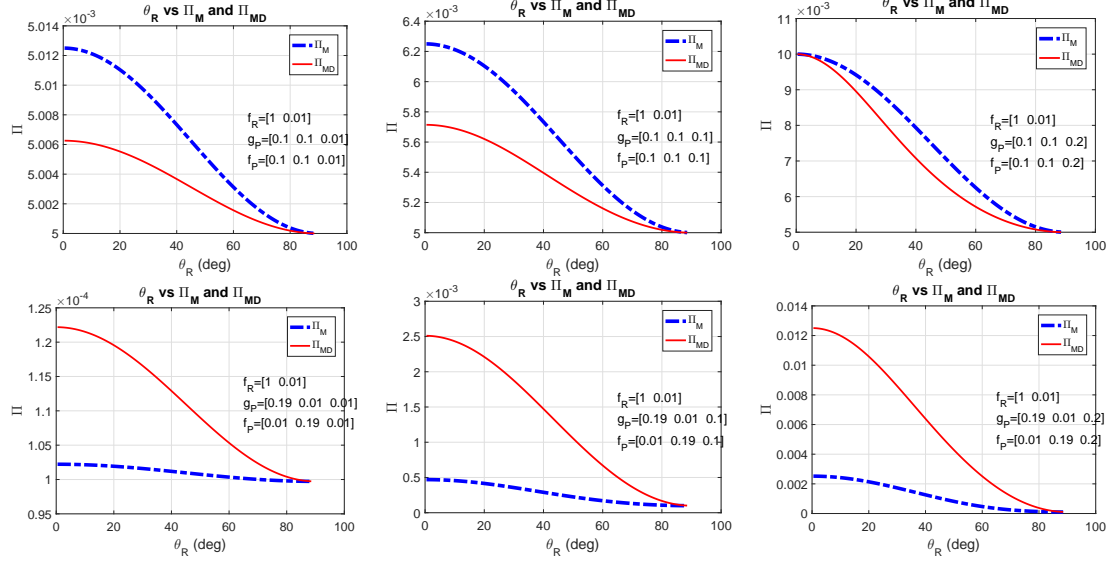


Figure 3.1: M's Profits as a Function of θ_R under Traditional Sourcing and Directed Sourcing Structures

directed sourcing structure diminishes as the misalignment level for the second-tier supplier increases. In line with the finding in section 4.2, the two structures generate the same profits to all three supply chain players when R's performance measures completely misaligned with R's contribution.³

Second, I examine the impact of the misalignment level for top-tier supplier on each party's profit under several conditions. Figure 3.4 shows the OEM's profits as a function of θ_P under traditional sourcing and directed sourcing structures, where θ_P is the misalignment between P's contribution and its performance measures and ranges from 0 to 90 degrees. The three figures in the first row show the OEM's profits under the conditions that the misalignment level for R (the second-tier supplier) is low, while P's performance is highly independent (upper left), moderately dependent (upper middle), and highly dependent (upper right), respectively. The three figures in the second row show the OEM's profits under the conditions that the misalignment level for R is high, while P's performance is highly independent (lower left), mod-

³To generate these figures, I set $f_R = [1 \ 0.01]$ and the norm of $\|g_R\|$ to 1, while change θ_R , the angle of f_R and g_R , from 0 to 90 degrees.

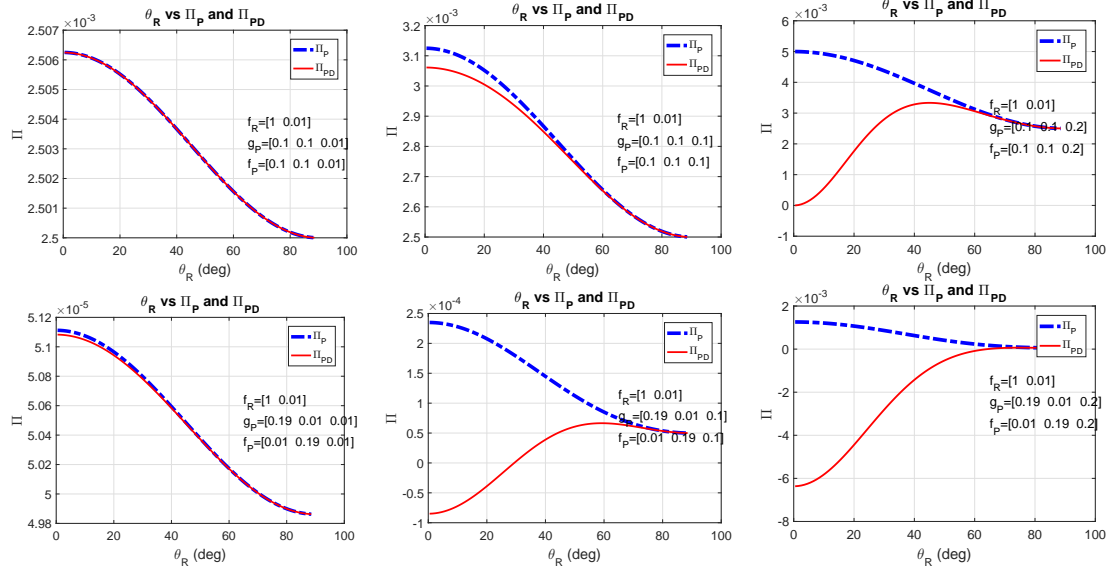


Figure 3.2: P's Profits as a Function of θ_R under Traditional Sourcing and Directed Sourcing Structures

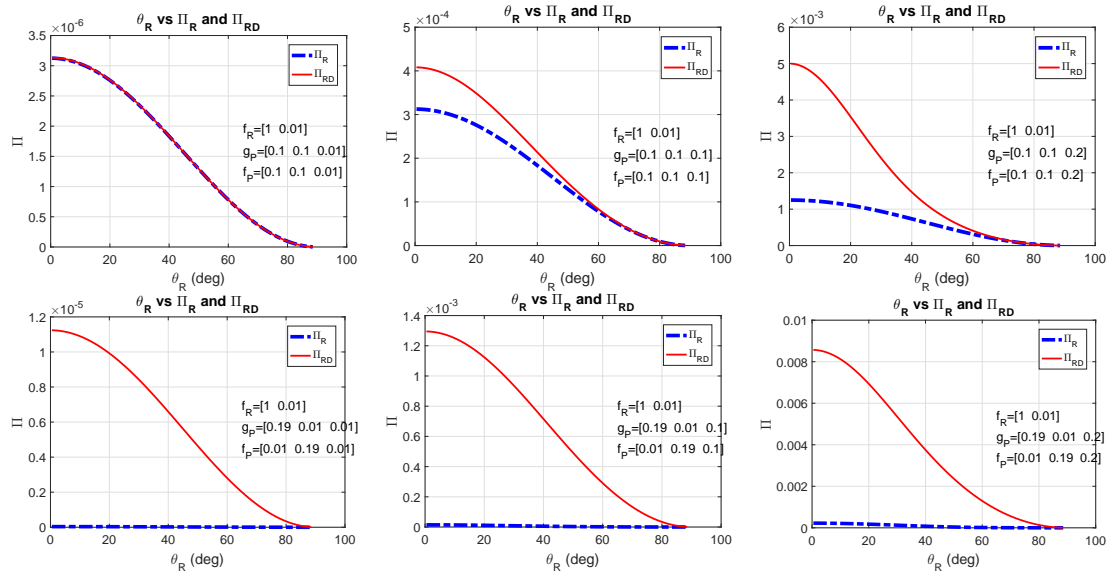


Figure 3.3: R's Profits as a Function of θ_R under Traditional Sourcing and Directed Sourcing Structures

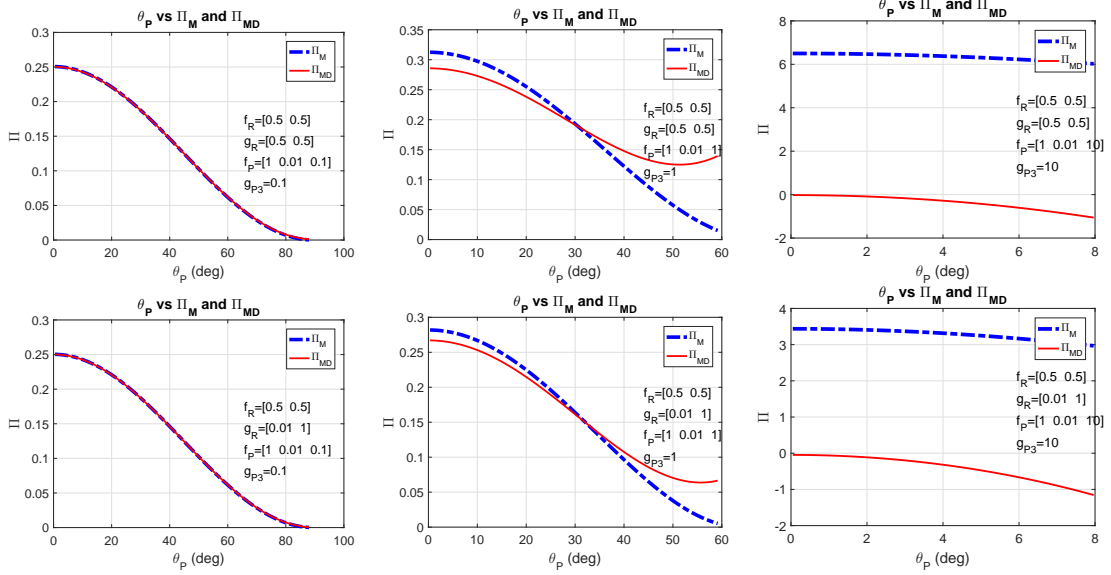


Figure 3.4: M's Profits as a Function of θ_P under Traditional Sourcing and Directed Sourcing Structures

erately dependent (lower middle), and highly dependent (lower right), respectively. In general, the results show that, if P's performance is highly independent to R's contribution (upper left and lower left in Figure 3.4), the OEM generates the same profits under the directed sourcing structure as under traditional sourcing. If P's performance is moderately dependent to R's contribution (upper middle and lower middle in Figure 3.4), the OEM generates the lower profits under directed sourcing structure than under traditional sourcing when P's misalignment level is low; but as P's misalignment level increase, the difference decreases and after a certain point, the directed sourcing structure outperforms the traditional sourcing structure. If P's performance is highly dependent to R's contribution (upper right and lower right in Figure 3.4), the OEM generates lower profits under the directed sourcing structure as under the traditional sourcing. Therefore, whether the directed sourcing outperform the the traditional sourcing structure depends on how accurately the OEM can assess top-tier supplier's contributions using the objective performance measures.

Figures 3.5 and 3.6 show P's and R's profits as a function of θ_P under traditional

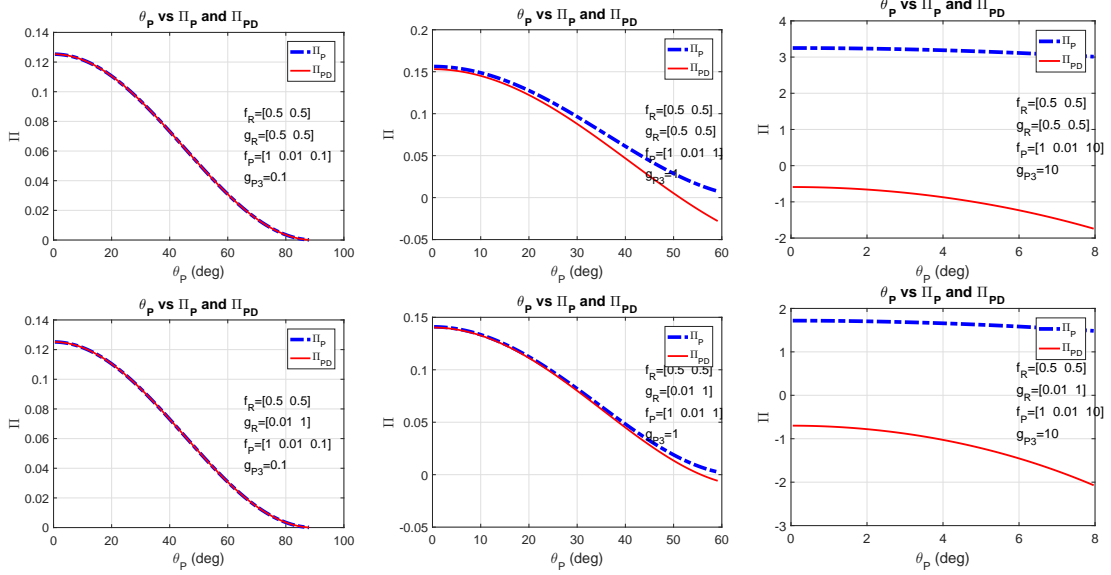


Figure 3.5: P's Profits as a Function of θ_P under Traditional Sourcing and Directed Sourcing Structures

sourcing and directed sourcing structures, respectively. Both sets of figures follow the same order of conditions as in Figure 3.4. In general, the results show that the top-tier supplier generates a lower profit, while the second-tier supplier generates a higher profit under the directed sourcing structure than the traditional sourcing structure. In addition, the differences increases as P's misalignment level increases. Therefore, directed sourcing structure generally benefits both the second-tier supplier but harms the top-tier supplier's profit, and the benefit to the second-tier supplier increases as P's misalignment level increases.⁴

Finally, I examine how the dependence of top-tier supplier's performance on second-tier supplier's contributions influence each party's profit under several conditions. Figure 3.7 shows the OEM's profits as a function of β under traditional sourcing and directed sourcing structures, where $\beta = \frac{g_{P3}^2 \|g_R\|^2}{g_{P1}^2 + g_{P2}^2}$ is the dependence level of P's performance on R's contribution, a higher value for β indicates P is more de-

⁴To generate these figures, I set $f_P = [1 \ 0.01 \ 1]$, while change g_{P1} and g_{P2} , so that θ_P , the angle of f_P and g_P , changes from 0 to up to 90 degrees.

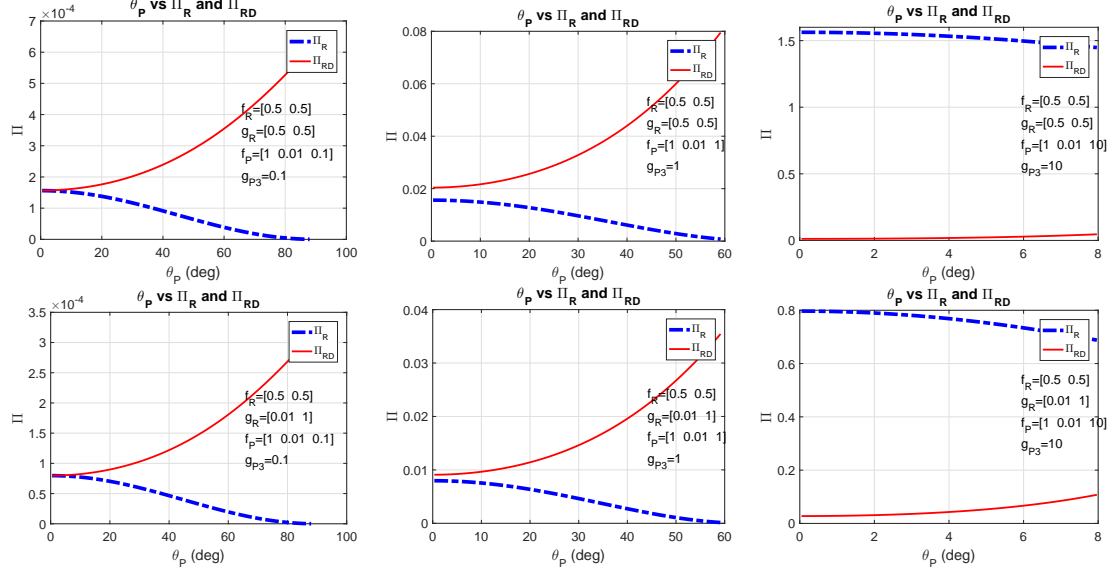


Figure 3.6: R's Profits as a Function of θ_P under Traditional Sourcing and Directed Sourcing Structures

pendent on R. The two figures in the first row show the OEM's profits under the conditions that the misalignment level for P (the top-tier supplier) is low, while the misalignment level for R (the second-tier supplier) is low (upper left) and high (upper right), respectively. The two figures in the second row show the OEM's profits under the conditions that the misalignment level for P (the top-tier supplier) is high, while the misalignment level for R (the second-tier supplier) is low (lower left) and high (lower right), respectively. In general, the results show that, if the misalignment levels for both P and R are low, the OEM generates a higher profit under the directed sourcing structure than traditional sourcing, but the difference generally increases as P's independence level increases. On the other hand, if one of the misalignment levels for either P or R is low and the other is high, the OEM generates a similar and slightly higher profit under the directed sourcing structure than under the traditional sourcing structure.

Figures 3.8 and 3.9 show P' and R's profits as a function of β under traditional sourcing and directed sourcing structures, respectively. Both sets of figures follow

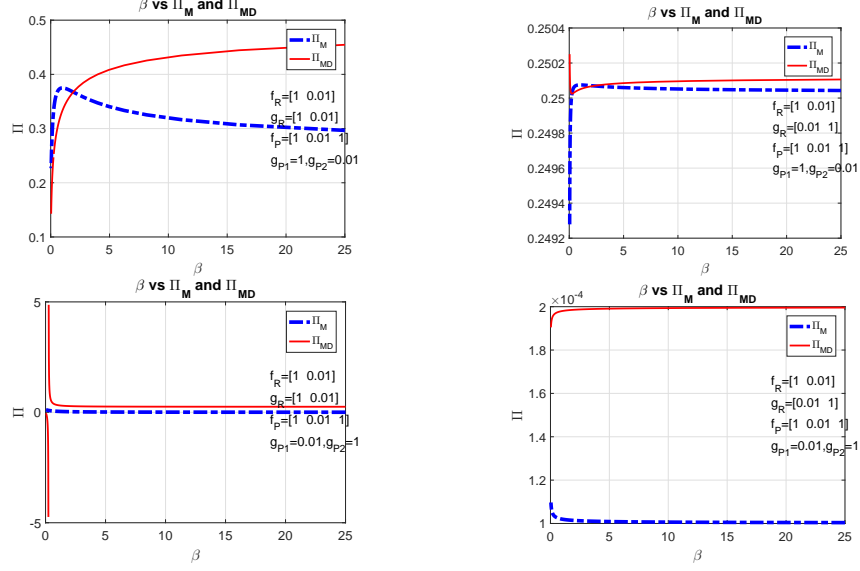


Figure 3.7: M's Profits as a Function of β under Traditional Sourcing and Directed Sourcing Structures

the same order of conditions as in Figure 3.7. In general, the results show that the top-tier supplier generates same level of profit, except that the profit level is higher in traditional sourcing when the misalignment levels for both P and R are low, and the difference decreases as the independence level increases. For R, the results are similar to M: if the misalignment levels for both P and R are low or high, R generates higher profit under the directed sourcing structure than the traditional sourcing structure, and the difference generally increases as P's independence level increases; and if one of the misalignment levels for both P and R is low and the other is high, the OEM generates a similar and slightly higher profit under the directed sourcing structure than under the traditional sourcing structure. Therefore, the directed sourcing structure generally benefits the second-tier supplier but harms the top-tier supplier's profit, and the benefit to the second-tier supplier increases as P's independence level increases ⁵.

⁵To generate these figures, I set $f_P = [1 \ 0.01 \ 1]$, while change g_{R3} from $\frac{1}{5}$ to 5 so that β changes from $\frac{1}{25}$ to 25.

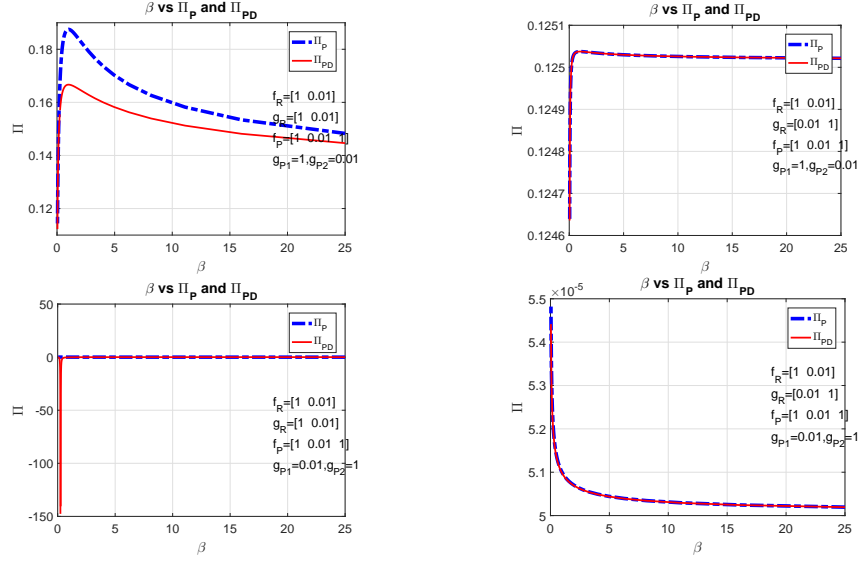


Figure 3.8: P's Profits as a Function of β under Traditional Sourcing and Directed Sourcing Structures

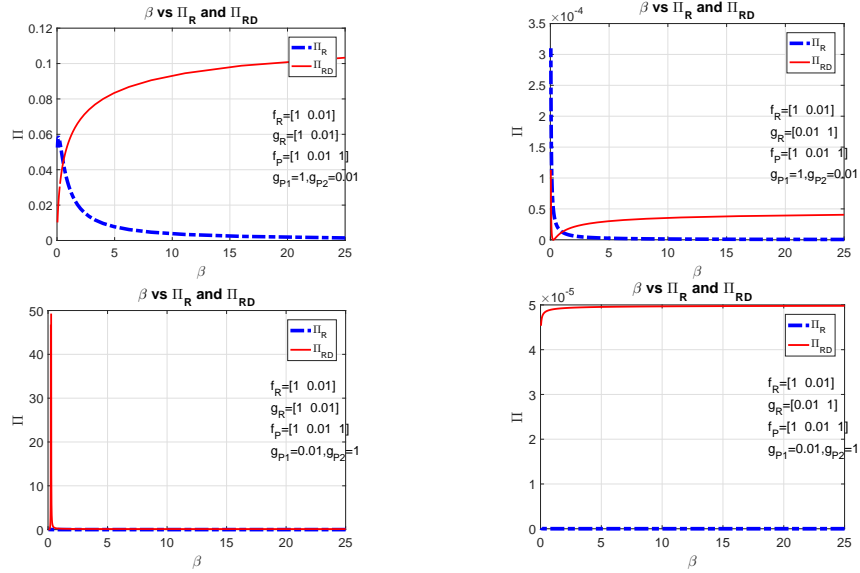


Figure 3.9: R's Profits as a Function of β under Traditional Sourcing and Directed Sourcing Structures

3.6 Discussion and Conclusion

Directed sourcing is an emerging practice adopted by several industry leaders and, yet, research that examines the potential benefits and the underlying issues associated with this new supply chain structure is still in its infancy. By developing the triadic multi-task model, this study quantifies the benefits and the challenges of direct sourcing for each supply chain party. In particular, I started by analyzing each party's optimal actions under the two supply chain structures and compared their payoffs in the general case. I also investigated two special cases with different levels of goal incongruence: one with no goal incongruence given the performance measure and the true contribution are perfectly aligned (the no misalignment condition, and the other with maximum goal incongruence given that the performance measure and the true contribution are orthogonal (the complete misalignment condition). Furthermore, I conducted numerical analysis to further illustrate the findings.

The analysis results from the general case indicate that the bonus terms for the top-tier and second-tier suppliers are positively associated under the traditional sourcing structure. In other words, top-tier supplier will pass on the reward or risk from the OEM to the second-tier supplier in traditional sourcing. This chain effect is commonly seen in practice: when manufacture gradually squeeze the top-tier supplier's profit by reducing the bonus rate, the top-tier supplier will also deliver this reduction to the second-tier suppliers. In this case, the second-tier suppliers are facing the risk of bankruptcy if they do not have much buffer to absorb the squeeze of their profits. On the other hand, the bonus terms for the top-tier and second-tier suppliers are negatively associated under the tiered sourcing structure. In other words, the top-tier and second-tier suppliers are competing for the bonus as one increases while the other decreases. The chain effect is avoided under the directed sourcing struc-

ture in that the top-tier supplier cannot pass on financial pressure to the second-tier supplier, but, instead, this structure creates tension between the two parties, which could potentially benefit the OEM (Burt, 1992).

The analysis results from the special case under the no misalignment condition indicate that the OEM is better off under the directed sourcing structure if the supplier dependency is high. The results also indicate that the top-tier supplier is always worse off under the directed sourcing structure, which echos empirical evidence that top-tier suppliers normally resist the implementation of directed sourcing (Kim and Hur, 2015), and the second-tier supplier always benefits from the directed sourcing structure. These results also imply that directed sourcing does not always outperform the traditional sourcing even from the OEM's perspective. Therefore, OEMs should be selective in adopting this strategy to a certain component based on how much the value of the component is dependent on the second-tier supplier as well as how accurate the contribution of each party is measured by the objective performance. From the analysis result for the special case in which the performance measures for the second-tier supplier is orthogonal to its actual contribution, i.e., the measures are completely misaligned, each party gains the same profit under the two structures. In other words, under the complete misalignment condition, directed sourcing does not improve the situation.

The results from numerical analysis illustrate that directed sourcing structure generally benefits the OEM and the second-tier supplier while it harms the top-tier supplier, which is consistent with the results from the analytical model and with empirical evidence (Choi and Linton, 2011; Kim and Hur, 2015). The results also show that the difference between the two structures generally decreases as R's misalignment level increases and as P's misalignment level decreases. In addition, there are conditions under which the OEM is worse off in directed sourcing. These results are

consistent with the analytical findings and indicate that the OEM should be selective in implementing the directed sourcing strategy, and the resistance from the top-tier supplier might be overcome under certain conditions. Finally, when the misalignment levels are low within any dyad, the benefit of directed sourcing to the OEM is increasing as the top-tier supplier's dependence on the second-tier supplier increases. This observation is also consistent with empirical evidence that the OEM should directly work with those second-tier suppliers who provide critical components (Choi and Linton, 2011; Yan et al., 2015).

Beyond the current study, I propose several directions for future studies. First of all, I assumed that the P's actions are independent to R's contribution. However, it is more realistic to assume that at least one of the actions should be related to R's contribution. For example, if R delivers the raw material late, P will need to make more of an effort and incur a higher cost in order to deliver to M on time. Second, I assumed that all three parties are risk-neutral so that the expected pay-off can be used as the objective function. It is more realistic to assume the three parties have different risk attitudes. For example, it's common that M, P, and R are large, medium and small size firms, respectively. In this case, their risk attitudes are likely to be neutral, somewhat risk-averse, and extremely risk-averse. Therefore, future research can take risks into consideration and investigate how the two structures affect each party's profits. Finally, future research may also be conducted to collect more specific information regarding the level of goal incongruence and each party's performance, and to empirically analyze and test some of the findings. Such empirical studies should complement our analytical work and provide richer insights to the directed sourcing strategy.

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